Socio-economic and Behavioural Influences on Child Undernutrition in Sri Lanka

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Declaration

Except where it is indicated otherwise, this thesis is my own work carried out during my PhD scholarship in the Demography Program in the Division of Demography and Sociology, Research School of Social Sciences, at the Australian National University.

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Abstract

The influences of socio-economic and behavioural characteristics on child undernutrition in Sri Lanka are examined in this study. Anthropometric data on length and weight of children aged 3-36 months is used. The data, the Sri Lanka Demographic and Health Survey, 1987, was collected from a representative sample of all areas in Sri Lanka, except for the eastern and northern provinces. To express the observed nutritional level of children, z-scores, derived by comparison with WHO-NCHS growth reference values were used: those with z scores of -2.00 or below were considered to be undernourished. In the assessment of nutritional status low length for age (stunting), low weight for age (underweight) and low weight for length (wasting) were used. It was found that more than a quarter of children are stunted and about 12 per cent are wasted. The proportion underweight is slightly higher than that of stunting. Children living in the estate plantations are most affected by stunting followed by those in the dry zone rainfed farming areas.

The higher prevalence of stunting among the estate children was a result of the socio-economic deprivation of the estate labour population (who are mostly of Indian origin); lack of integration with the indigenous community; exposure to short breast-feeding periods and late food supplementation. Children in the dry zone rainfed farming areas normally have longer breastfeeding periods but have little food supplementation at the appropriate time.

Logistic regression models were fitted separately for stunting and wasting to identify the effects of socio-economic and behavioural factors on the two outcome variables. The results of the models show that urban, rural and estate residence, age of the child, joint education of the parents, interval length between live births, and place of confinement are variables significantly influencing stunting. For wasting, child's age, housing type (defined according to materials used for the construction of the roof, walls

and floor), and source of drinking water are significant. The study treats housing type and source of drinking water as proxies of environmental exposure; their effects on wasting are mediated by infections.

The association of housing type with wasting was in the expected direction: the prevalence of wasting increased as housing type deteriorated. The relationship found between the source of water supply and wasting was somewhat different from the expected pattern; although prevalence of wasting was low in houses with access to piped water, slightly higher prevalence of wasting was associated with protected wells than with unprotected wells or other unsafe sources; this is presumably associated with behaviours such as the practice of boiling water.

This research also examined the socio-economic determinants of weaning. A proportional hazard model is fit using current status data relating to lastborn children in the three years before the survey. It was found that better housing conditions, urban residence, mothers in non-agricultural occupations, and first birth-order is related earlier weaning.

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Chapter 1

Nutritional Status of the Population of Sri Lanka in the Context of Welfare Policy Change

1.1 Undernutrition: Global Levels

A recent global assessment of malnutrition in children, made for the UNICEF using current data from most developing countries, shows that a substantial proportion of children suffer from undernutrition: 36 per cent (or 150 million) do not have adequate weight for age (the adequate height or weight is determined in comparison with a normal child usually drawn from a growth reference); 39 per cent of children (or 163 million) have lower height (or length) than normal children of their age; and some 8 per cent (or 35 million) do not have adequate weight for their height (Carlson and Wardlaw, 1990). The problem of undernutrition is widespread in developing countries and particularly severe in South Asia, where almost half of all the undernourished children of the world live today (Carlson and Wardlaw, 1990:12-13). Sri Lanka, even with impressive reductions in mortality, in particular infant and child mortality, is no exception.

1.2 Undernutrition in Sri Lanka

In Sri Lanka current estimates of child nutritional status show that 28 per cent of children in the 3-36 months age group are undernourished in that they have inadequate length for their ages (what is meant by adequate length or weight is discussed later in Chapter 3) while some 38 per cent do not have adequate weight for age. Nearly 13 per cent do not have adequate weight for the attained length (Department of Census and Statistics, 1988). These assessments are based on the age, weight and length measurements of children; there is also other evidence which can be used to assess the nutritional status of the population in general. For instance, for the country as a whole, it is estimated, that one quarter of the babies born each year do not have a minimum

weight of 2500 grams at birth (Mel and Aberatne, 1979). Anaemia among mothers, mainly arising from iron deficiency, is widespread in Sri Lanka, much more than is reported in available statistics (Nagaratnam, 1979:108); around 1978, according to a rough estimate, 20-30 per cent of pregnant and lactating women and a similar percentage of pre-school children were considered to be suffering from anaemia (Government of Sri Lanka, 1985).

Surveys have shown that vitamin A deficiency in children, measured in terms of prevalence of Bitot's spots and night blindness, is not sufficiently prevalent, for the country as a whole, to be considered a public health problem (a prevalence level above 2 per cent is considered a minimum level to require intervention), but is a problem in certain health districts (Brink *et al.*, 1979). About one fifth of all infant deaths in Sri Lanka are ascribed to a group of causes which includes symptoms and ill defined conditions: debility, convulsions and immaturity form the majority (Gaminiratne, 1984). This is in addition to the deaths directly ascribed to nutritional disorders, which rank as the fifth leading cause of infant death in 1978/79. The proportion of infant deaths classified as due to immaturity and infantile debility alone shows that malnutrition is a significant health problem among pregnant women (Immerwahr and Pollack, 1983:31) because these infants normally have low birth weight. Reviewing the available evidence on the well-being of children in Sri Lanka, a status report to UNICEF, Colombo, concluded that undernutrition in Sri Lanka is a major health problem and that by the age of five years more than half of the children show signs of retarded linear growth (Gunatilleke, 1987:18).

1.3 Objectives of the Study

This research study has four major objectives. They are:

(a) to examine the levels of child undernutrition in Sri Lanka according to the type of undernutrition and to assess the variations by socio-economic and behavioural characteristics of the population;

(b) to assess child undernutrition as reflected in anthropometric indicators of weight

and height measurements of children according to a set of proximate determinants and to examine the influence of socio-economic and behavioural characteristics of the children, parents and the household;

(c) to assess the socio-economic determinants of weaning;

(d) to identify potential groups of high nutritional risks, according to socio-economic and behavioural characteristics: this is very important as some of these hard-core groups hitherto have not been identified as vulnerable in order to receive priority in program planning and service delivery;

(e) to examine the extent of sex differences in undernutrition among children, and to understand the socio-economic and behavioural characteristics giving rise to such differentials. This aspect is particularly important as until recently Sri Lanka mortality data consistently showed higher female mortality among children aged 1-4 and 5-9 years.

Before proceeding, it is necessary to give a brief account of the mortality trends in Sri Lanka and the public welfare and food policy of the government. Understanding broad trends in mortality (infant and child mortality in particular), and changes in welfare policy is very important as the latter has a direct impact on the former. The changes in food policy, particularly the food subsidy and rationing scheme, had significant effects on the nutritional level of the general population which in turn had its influence on child nutritional levels. It is therefore important in the study of child undernutrition to discuss these two aspects. Although the mortality decline in Sri Lanka began even before the Second World War, the discussion here is confined to the period since 1946 as the trends and patterns in mortality during this period are more relevant for the study.

1.4 An Overview of Post-war Mortality Decline in Sri Lanka

According to the mortality conditions that prevailed in the country, a boy born in 1946 could not expect to live more than 44 years and a girl not more than 42 years. Within a

year, however, the level of life expectancy rose to 53 years for males and 51 years for females. The trends in increased life expectancy continued rapidly over the years. By 1963 the average life expectancy had increased by about 20 years from the 1946 levels for both men and women (ESCAP, 1976:148, Table 110). The latest estimates (for 1981) showed further improvements. Longevity for males has reached 69 years and for females 71 years (Department of Census and Statistics, 1985). These are very close to those found in some contemporary developed countries.

The mortality decline in Sri Lanka has several unique features, the most important among them being magnitude and tempo. The crude death rate in 1947 was 21 per 1000 population and this declined to 17 in the following year; within seven years from 1946, the recorded decline in the crude death rate was slightly more than 50 per cent, an impressive achievement in comparison with the United States which took about a half a century to achieve such a level of decline (Hauser, 1967). There was no direct influence of economic development of the country on the decline in mortality. For instance, during the period of significant mortality decline in 1946-47 the per capita income was just under $80, while the 1981 life expectancy of 71 years was recorded with a per capita income of $250. As Preston and Gardner (1976) demonstrate, the 1963 life expectancy observed for Sri Lanka (63.2) was 10.5 years higher than the predicted level on the basis of national income.

There are three broad and distinctive phases of the decline in mortality. In the first phase from 1946 to about the middle of the 1950s the decline was very rapid, despite the improvements in coverage of registration of births and deaths (see Meegama, 1986 for a brief discussion on the reliability of mortality rates). The crude death rate fell from 20 to about 9 per 1000 population in 1959. The next phase covered a period of about 15 years till 1976. During this period the country encountered severe economic problems, mainly due to balance of payment problems (Gunatilleke, 1987). Year by year the imbalances grew, with increasing demand for basic needs from the rapidly increasing population whose survival chances had been improved in the first phase. The declining trend in mortality rate slowed down. The crude death rate

fluctuated around 8 per 1000 population. In fact, the crude death rate rose in 1974 from 7.7 (1973) to 8.9 per 1000 population when the country was devastated by a severe economic and food crisis (Meegama, 1981). The third phase was a revival of the rapid decline which came after the food crisis and coincided with the formation of the new government and its policy implementation in 1977.

While the declines in mortality in Sri Lanka during the whole period were common to all age groups and both sexes, declines recorded by infants, children and women in the reproductive ages were greater than in the rest of the population. For instance, the relative contribution of the childhood ages to the overall mortality decline during 1945-47 and 1952 was about 40 per cent (Ruzicka, 1975), and it was about 20 per cent between 1971 and 1981. The increases in longevity among females were very rapid and the disadvantage they had in life expectancy over males, an exceptional pattern found in Sri Lanka and a few other countries, diminished in the early 1960s for the population as a whole. After 1963 their life expectancy exceeded that of males (Nadarajah, 1983; Langford, 1984, 1987; Caldwell and Caldwell, 1986). Yet girls in certain age groups, such as 1-4 and 5-9 years, continued to have a slight disadvantage, a pattern which existed even during the 1963-1971 intercensal period (Langford, 1984:404). The female disadvantage in mortality remaining among these young age groups gradually became less marked and there is evidence that it had disappeared for the country as a whole by the middle of the 1980s (Department of Census and Statistics, 1988).

1.4.1 Infant and child mortality

In 1946 the infant mortality rate was around 140 per 1000 live births; it dropped to 101 in the following year and continued to fall rapidly during the next decade. In the 1950s the infant mortality rate was about half of the 1946 rate. In the decade from 1960 it reached a plateau of around 50 per 1000 live births and this lasted till 1970 after which it was around 46, until it rose suddenly to 51 in the wake of a food crisis. Thereafter the infant mortality rate began to decline rapidly and by 1985 it registered a low level of 25

(Figure 1.1). The child mortality rate also showed a corresponding decline over the years, declining from 27 deaths per 1000 children in 1947 to 18 in 1953. It was 6.2 in the year following the food crisis of 1974 and declined to 3.0 by 1981 (Figure 1.1).

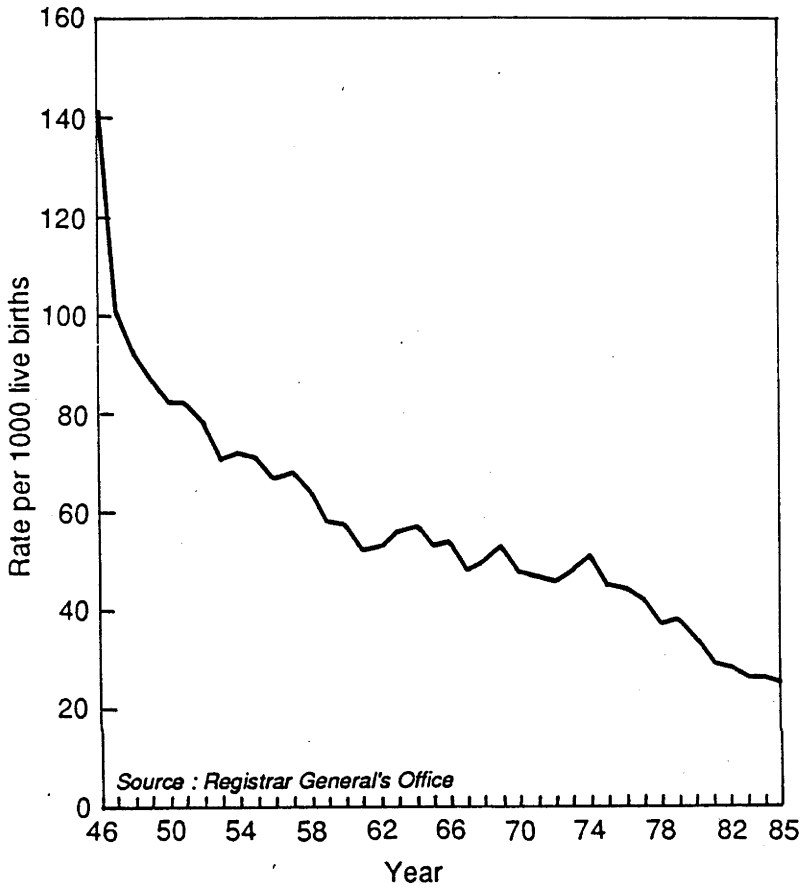

Figure 1.1 Trends in infant mortality, Sri Lanka, 1946-1985.

1.4.2 The causes of mortality decline

The decline in mortality, particularly in the post-War period, is the result of a number of factors but their relative contributions are the subject of much debate. Except for malaria control which was a major issue in Sri Lanka, other issues mainly echoed the debate over the relative contribution of medical and economic factors in the 19th century mortality decline in Europe. Among the factors identified as having particularly operated in Sri Lanka to cause the overall decline in mortality were expansion of maternal and child health care services; eradication of malaria;

improvements in the environment and the general nutritional level of the people as a result of the state sponsored welfare and food policy.

Malaria has been a killer disease in Sri Lanka for centuries. Control of malaria using DDT began in Sri Lanka in 1945 and covered the entire endemic zones by 1947. The malaria mortality rate dropped by one quarter in 1950 from a high of 10 deaths per 100,000 which was the level before 1947. The controversy over the relative share of malaria eradication in the decline in mortality is, however, not yet resolved (Meegama, 1967; Newman, 1970), but according to a review of the controversy it is estimated that about one quarter of the decline is attributable to that cause and the remainder to other factors (Gray, 1974).

Among these other factors the state welfare services were particularly important. These included free education even up to university level, free health services, free midday meals for school children, food subsidies and a food rationing scheme. Some of these measures began even before Independence (1948). Food rationing began as a war-time measure. State investment in education increased the general literacy of the population, and particularly of women; the investments in health reduced mortality from a host of causes: both these assisted in raising the public health consciousness of the population. Successive governments since Independence continued with the massive welfare and subsidy program although it was found to be out of proportion to the country's budget (Marga Institute, 1974). The state took responsibility for the procurement of basic food items, and distributed them through a large network of retail outlets, mainly co-operative societies. When there was a shortage of any of the essential food items they too were brought under rationing, while for other items comprehensive price controls were used. According to the system operating in the 1970s, between 45 and 75 per cent of rice, the staple food, moved through the public distribution system. Similarly, in any normal year, approximately one third of the country's calories and about 25-30 per cent of the protein flowed through the state distribution network (Gwatkin, 1979:249-250).

According to Meegama, the availability of food played an important role in lowering death rates in Sri Lanka; after the export-import trade was established, famines became a rare event and `the increasing availability of stable supplies of food seems to be the key to understanding the lowering of mortality levels in the nineteenth century' (Meegama, 1986:11). He argues that the improved nutrition of the population, as a result of greater availability of food, has been a major determinant in the post-war mortality decline.

Gwatkin (1979) placed the emphasis on food distribution rather than availability *per se* as the primary cause of mortality decline in recent decades. Considering the relationship between overall food availability and mortality observed in Asia as a whole and other countries, Gwatkin estimated the life expectation of Sri Lanka on the basis of food availability and found that the observed life expectancy was 10 years lower than the 63 years observed around 1971 (Gwatkin, 1979:252). The main factor for the excess of longevity achieved, according to Gwatkin, was the egalitarian food distribution: in a normal year even the poor had a minimum calorie level while in a crisis situation the calorie consumption of both the poor and the rich declined. Recently, in a human development index constructed using life expectancy, literacy and income of the population for a decent living, a United Nations Development Program report ranked Sri Lanka second in Asia, after Malaysia (UNDP, 1990:16). Such achievements in the field of human capital development for a country with a low per capita income are extraordinary by any standards. These achievements, it has been argued, could be considered to be a result of state welfare policies (Preston and Gardner, 1967; Gunatilleke, 1989).

1.5 Social Welfare: Food Subsidy and Food Rationing Scheme

Sri Lanka was one of the few countries in the developing world which had adopted the policy of public investment in the field of social welfare as early as the 1930s and 1940s when the country was still a British colony. Except for the estate population who received staple foods and other essential goods distributed by the estate authorities at a

subsidized price which had existed for a long time, the rationing of food for the population was a war-time measure designed to assure the equitable distribution of essentials at a reasonable price.

Since Independence the subsidy and rationing scheme were not only continued but also gradually expanded by successive governments. An attempt to increase the price of rationed rice in 1953 was met with public unrest, mainly from organized labour. Besides the investments in social overheads such as education and health, the welfare program included a comprehensive food subsidy scheme covering almost every household in the country. As it operated in the early 1960s, each person was eligible to receive two rice measures (4 lbs) per week at a very reduced price. Following the economic slump after the Korean War, the country experienced enormous economic problems which were aggravated in the 1960s. In 1965 the rice ration to which individuals were entitled was halved but given free of charge. In 1972 the ration was restricted to non income-tax payers. In 1974 Sri Lanka faced severe food shortages as a result of several factors apart from the usual foreign exchange limitations which have been a characteristic feature in the country; in 1971 there was a civil war; continued droughts affected local production; world market prices of food items rose rapidly; and the oil price increase in 1974 further reduced import capacity. All these culminated in a serious food shortage in the country. The government suspended off-ration flour distribution and the flour was distributed only to bakeries but in very limited quantities. The food crisis did not last for long and the situation returned to normal in the following year.

The new government which came to power in 1977 reviewed the existing welfare policy, and several far-reaching changes were made to it. It concentrated more on economic growth than the continuation of the welfare policies which were associated with low growth. As part of the policy reforms the government wished to cut down the expenditure on food subsidies which formed about 20 per cent of its total expenditure. The changes to the food subsidy and rationing scheme were effected in three stages: in the first stage it was restricted to households receiving a monthly income of less than

Rs.300: this brought down the number of beneficiaries by 50 per cent (Edirisinghe, 1988). In the next stage, the rationing scheme was replaced with a food stamp scheme. The value of food stamps was fixed on the basis of household composition or family size: children under eight years of age received stamps to the value of 25 rupees; those between 8 and 12 years stamps to the value of Rs.20; others to the value of Rs.15. In addition stamps to the value of Rs.9.50 per month were given to a household to be used for the purchase of kerosene (Gavan and Chandrasekera, 1979). Within the amounts due to the household any items offered under the food stamps scheme could be purchased. Still the food subsidies on a number of food items including several brands of infant milk were continued. In the third stage subsidies granted for food items were withdrawn, except for a very few brands of infant formula milk, by 1980. As a result expenditure on food subsidies dropped from Rs.2326 million in 1979 to Rs.305 million in 1980 (Edirisinghe, 1988:255). Still about half the households in the country were receiving food stamp benefits while many others were seeking enrolment. The new issue of food stamps and revision of food stamp values according to new births were frozen by March 1980.

In 1982 the food stamp scheme was reviewed in the light of inflation and the apparent worsening of the situation among the poor groups, some of which were highlighted in the survey of food stamp beneficiaries carried out by the Food and Nutrition Policy Planning Division (FNPPD, 1981:25-36). As a result consideration of some relief to other income groups (between Rs.301 and Rs.700 per month) was given, by entitling some household members to food stamps in the following way: households whose declared income falls between Rs.301 and Rs.400, four members; Rs.401-600 three members, and Rs.601-700 two members. The value of kerosene stamps was also increased to Rs.21.73, to compensate for the rise in energy prices; the benefit was, however, restricted to households without electricity. No attempt was made to compensate for the decline in the real value of the food stamps; this was precluded by resource constraints (Bandaranaike and de Alwis, 1987:170). Similarly, no action was taken to provide food stamps for children born since the new issues were frozen in

1980. Later, the management of food stamps was transferred from the Department of Food to the Social Services Ministry and the stamp scheme was renamed `Poor relief food stamps': a name intended to discourage certain recipients from enrolling because of the social stigma supposed to be attached to it. There was, however, no significant drop in the number of beneficiaries.

1.6 Impact of Policy Changes on Nutritional and Social Welfare

One of the major aspects of the food policy which operated for several decades after Independence was provision of the basic food items at a reasonably low price. This and the provision of health and education jointly had an important influence on the low mortality achieved in the past four decades. The 1974 food crisis provides a very good example of how even a temporary shortage of food can affect the longevity of poor people who do not produce their own food and live on a marginal income (Isenman, 1980:284). Meegama (1982, 1986) illustrated this using registration data for the estate population, a group which suffered the most from the crisis and for whom data are available.[1] Death rates among the estate population increased for all age groups in 1974 compared with 1973; the crude death rate rose from 7.7 to 8.9 per 1000 population. Among the infants the mortality rate increased by 50 per cent for boys and 67 per cent for girls. The post-neonatal mortality in the estates rose by 150 per cent. Among children in the 1-4 age group mortality was about the same for both sexes and the increase was low, 29 per cent. Overall, females were affected less in the food crisis year; particularly among the 35-64 age group. The low increases among children aged 1-4 and women in general show that these groups had high mortality levels in normal years (Meegama, 1982:367, 1986:11; Langford, 1984). Later, Arriaga and Way (1987) computed life table values for 1973 and the crisis year 1974 for the estate sector, based on several assumptions concerning the age distribution of the estate population; they speculated that factors which caused the higher female mortality in a normal year were

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[1] Others, landless peasants and urban poor groups also suffered from the crisis but no data are available to examine the impact.

not operative in the famine year, and concluded (probably more strongly than the evidence permits) that under adverse nutritional circumstances more females than males survive (Arriaga and Way, 1987:46-47).

According to the 1980-81 Socio-Economic Survey of the Department of Census and Statistics (DCS) for Sri Lanka as a whole, rice, bread, wheat flour, coconut, and sugar altogether provided 80 per cent of the total household calorie intake (Shan, 1988:318). The estate population are the largest consumers of wheat flour — their average consumption in a year being 75.2 pounds compared to about 14 pounds among the urban and rural population. Thus the withdrawal of subsidies on wheat flour undoubtedly had an adverse impact on the estate population, while the urban households who consume more bread than any other sector also must have been affected.

The increase in mortality in the food crisis year affected all segments of the population and even infants and children. The important point is that the effects of such temporary interruptions in food supply on mortality were immediately noticeable only in the estate sector, where the planters' association had up-to-date data on mortality in the resident labour population. As the excessive mortality was reported to the Cabinet, it immediately granted an additional flour ration to the estate population. Leaving aside the long delays in producing details of vital statistics on mortality (Gaminiratne, 1984), the lowest levels at which detailed data on mortality are produced are only the district and urban, rural and estate levels. Thus even the socio-economic groups which are vulnerable and affected by even a small change in food supply, cannot be identified from the available statistics for program assistance. The delay in producing statistics makes it more difficult to identify immediately such problems and act quickly to remedy the situation.

The changes in government policy at the macro-level were visible in the national income figures; the growth of real gross domestic product reached a very high level of 7.8 per cent per year in 1978 and continued at an average rate of 5.9 per year

during 1978-1984 compared with 2.9 per cent in the preceding five years. The Gross National Product, however, did not grow as rapidly as the GDP owing to unfavourable external income. The overall cumulative growth in GNP during 1978-84 was 27 per cent but the per capita income was low and stood at US$340, indicating an insignificant growth for the lower income groups (UNICEF, 1988:239).

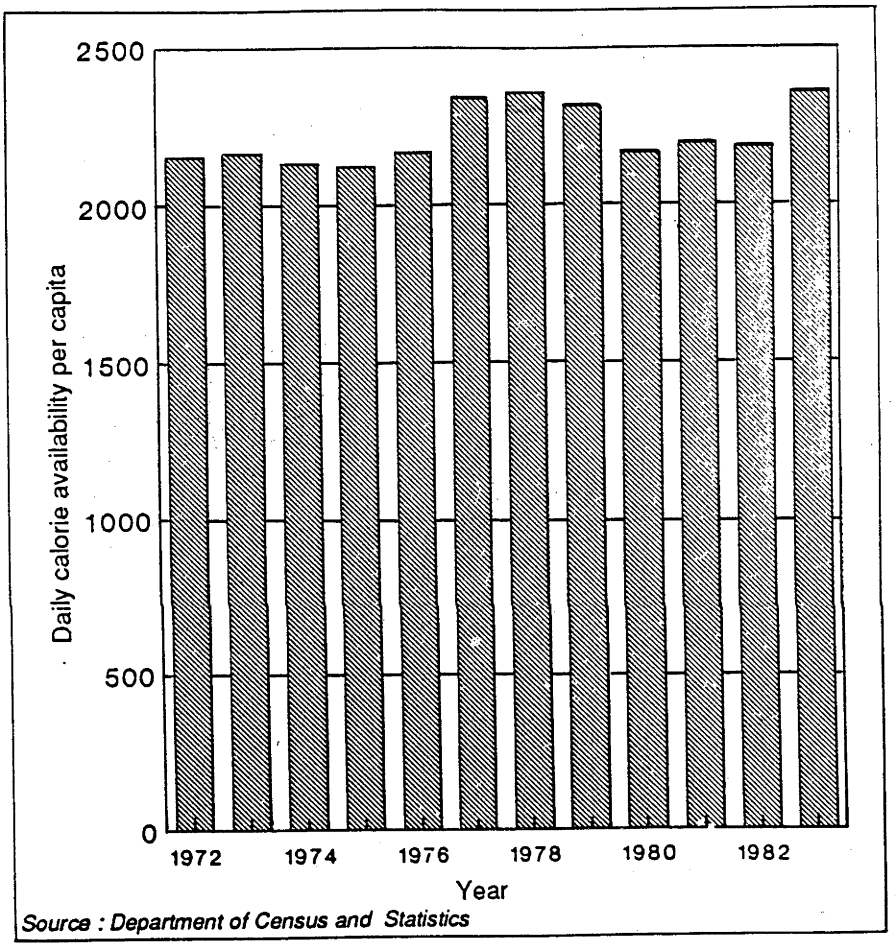

Figure 1.2 Distribution of daily per capita calorie availability in Sri Lanka, 1972-1983.

With the removal of market controls, the reliance on market forces and the gradual expansion of the private sector in importing food items, the per capita availability of food increased rapidly: the increase in the production of food grains also increased as a result of expansion of cultivated land and other water development projects (ESCAP, 1985:11). For Sri Lanka as a whole, according to the data from the food balance sheets, per capita calorie availability increased from 2243 in 1977 to 2325

in the following year and although there were slight drops in 1980 and 1982 the level of availability was generally above the recommended minimum average of 2200 calories per day per person (Figure 1.2).

While the per capita availability of calores was favourable, the consumption data show that overall calorie consumption among the population was virtually unchanged between 1978-79 and 1981-82. Yet the average calorie consumptions per day per person were 2283 and 2271 respectively for the above two years: slightly ahead of the minimum requirements of 2200. There was, however, clear evidence that the calorie consumption of the poor deteriorated during the period: calorie consumption declined for the lowest decile from 1335 to 1181 and for the second lowest decile from 1663 to 1558 (UNICEF, 1988:265, Table 9.18). This point is more clearly stated by Edirisinghe (1988:262):

> While calorie inadequacy *vis-à-vis* recommended allowance has continued to be a problem of the bottom five deciles, the nutritional position of the poorest two deciles had deteriorated significantly by 1981/82. The decline registered is around 122 calories per day or 8 per cent from their already low levels of calorie intake of about 1500 calories per day.

The relaxation of price controls, withdrawal of subsidies, lack of control over market forces and devaluation of the rupee and its continuous depreciation have caused inflationary tendencies for almost all consumer goods; the trends in selected items of goods and services derived from the Colombo consumer prices as shown in Table 1.1 show very clearly the price movements following the policy changes. Compared to 1977 prices, the price levels for all items rose in 1981 by about 172 per cent while the price of food items increased by nearly 200 per cent. The price of fuel and lighting rose following the second oil shock in 1979 and their price in 1984 was about 400 per cent higher than the 1977 levels.

Despite the increase in prices the value of the food stamps, fixed at the time of their implementation, remained unchanged over the years. Restricting the ration to the lower income groups who were not receiving a monthly income of Rs.400 affected different population groups differently: as a group, estate workers not only had their

money income readily recorded with the management, they also had on average more working members in the household than families in urban or rural areas; the average number of household members earning a money income was 1.6 in urban, 1.5 in rural and 2.5 in estate sectors.

Table 1.1 Trends in Colombo consumer price index (CCPI), for selected items 1975-1983 (1977=100).

Year	All	Food	Fuel & Light	Clothing
1975	97.6	100.5	92.1	93.0
1976	98.8	99.4	103.0	103.0
1977	100.0	100.0	100.0	100.0
1978	112.1	116.8	101.8	101.1
1979	124.2	129.5	127.6	103.0
1980	156.6	167.1	219.0	107.0
1981	184.7	196.6	298.2	115.2
1982	204.8	221.5	317.0	115.2
1983	272.2	294.1	398.1	137.4
% change 1977-84:	172.0	194.0	398.0	37.0

Adapted from UNICEF (1988; 245, Table 9.5)

Thus when the food ration entitlement was restricted to low income groups the estate sector was affected, most of them had wages above Rs.300 per month (Edirisinghe, 1988). The other group which suffered from the change was the urban working class who had a fixed income, even slightly higher than the cut-off, which could not be concealed. In addition to their being engaged in formal or modern sector employment, most of those in the estate and urban sectors did not produce their own food; as a result most of these households depend largely on the market for staple foods and other food provisions, prices of which have been rising.

At first, the households were somewhat better-off under the food stamp scheme which gave food stamp values slightly higher than those they had enjoyed under the old ration and subsidy scheme; but the withdrawal of food subsidies without a compensatory revision of food stamp values adversely affected the beneficiaries. The increased prices, on the other hand, further reduced purchasing power; with the rising

prices the average share of household expenditure on food rose from 66 per cent in 1978/79 to 68 per cent in 1981/82 (Edirisinghe, 1987, 1988:260).

With the removal of subsidies and the price control net and the policies associated with the liberalization of the economy, inequalities increased in the national income distribution. The Gini coefficient[2] which was 0.50 in 1953 declined to 0.49 in 1963 and 0.41 in 1973; in 1978-79 however it showed a rising trend, reaching 0.49, and in 1981-82 it further increased and reached 0.52 . The survey data collected by the Central Bank of Sri Lanka for the years 1973 and 1978/79 also demonstrated decreases in the percentage share of income among the two lower quintiles in the rural and urban sectors, and marginal increases in the share in the estates (Table 1.2).

Table 1.2 Percentage distribution of total income received by different income groups and sectors

	Income receivers					
	1973			1978/79		
	Urban	Rural	Estate	Urban	Rural	Estate
First 20 per cent	5.4	5.4	7.5	3.3	3.5	7.7
Second 20 per cent	11.0	11.6	1.7	8.5	8.6	13.2
Third 20 per cent	16.1	17.0	14.9	13.2	14.1	16.7
Fourth 20 per cent	45.3	42.7	45.2	55.7	53.0	40.1
Fifth 20 per cent	22.2	28.3	30.7	20.3	20.8	22.3

Source: Central Bank of Ceylon, Consumer Finance and Socio-economic Survey 1978/79, March 1983, Table 90 quoted in Gooneratne and Gunawardena (1983:248-249).

Because of the failure to restrict food stamp benefits to the poorest groups, the government failed to reap anticipated large savings, part of which could be utilized to protect the really needy groups. Households receiving a monthly income of less than Rs.300 amounted to 12 per cent according to the Consumer Finance Survey of 1978/79. This proportion would have been even lower if there was under-reporting of incomes in these surveys. According to Gunatilleke, if the 1979 cut-off is used in 1985-86 to identify households below the poverty line, then the cut-off roughly equals Rs.500 and

2 Gini coefficient measures the degree of inequality. The value of this index varies between 0 to 1. When the income distribution is almost equal, the Gini coefficient has a value closer to 0.

this will constitute about 33 per cent of the population (Gunatilleke, 1989:25).

The new policies were directed at achieving a better growth by curtailing the burden of food and other subsidies and improving the growth of domestic agriculture. There are noticeable increases in the national income growth and the production performance of agriculture, mainly paddy. The agricultural extension work carried out was also meant to help the rural poor to take part in economic activities and improve their earnings. Edirisinghe (1988) shows that the benefits of such work did not reach the `ultra poor', defined as those receiving less than 80 per cent of the recommended dietary allowance and whose expenditure on food is 80 per cent or more of their total expenditure. As shown in the data, `ultra-poor' workers in the agricultural sector have become worse-off. The incidence of ultra-poverty among the poorest 20 per cent has increased from 24 per cent in 1978-79 to 37 per cent in 1981-82 for the domestic agricultural labour population while the increase has been even almost similar for the plantation workers; the increase was from 14 per cent to 24 per cent in the same period (Table 1.3).

Table 1.3 Share of agricultural households that are ultra-poor, 1978-79 and 1981-82

Agricultural group	Poorest 20 per cent of house holds	
	1978-79	1981-82
General farmers	15.8	17.8
Plantation workers	14.0	23.8
Agricultural workers (paddy)	23.8	36.7

Adapted from Edirisinghe (1987:41, Table 25).

Thus the changes made to the food subsidy and rationing scheme have enabled slightly higher overall economic growth to be achieved. They tended to affect adversely the poorest sections of the economy. The decades-long rationing scheme and distribution and associated price controls in fact acted as a buffer protecting poorer groups. The problem with that system was that its benefits were virtually open to all. If

the benefits have been restricted to the most needy groups and protected them adequately, that system would have run effectively without incurring massive budgetary burdens. This was intended by the introduction of the food stamps scheme but the desired protection of the poorest groups of the population was not achieved, mainly because of the inability to identify properly the vulnerable groups.

1.7 Health Services

While the changes in the food policy were affected, certain changes were also made in areas of health. As part of the new policies the government abolished the five-year period of obligatory service for medical graduates which, however, helped the exodus of doctors to overseas countries. In 1977 the government also permitted all categories of medical officers and other technical personnel in the state health services to undertake private practice, the facility which medical specialists were granted in 1976. This was a measure taken to prevent the `brain drain' of qualified medical and health care personnel and also to attract high-level manpower to peripheral health centres. There may have been an economic motive as well: to the extent patients are seen by the doctors outside the hospital system the burden on the state health system will be reduced. Permitting private practice outside duty hours created a dual system which had two contradictory motives: one system operating on the basis of service and the other based on profit. This in many cases led to a deterioration of the state health services, as it gave preferential accessibility in the government health facilities to paying patients over the others.

Because of budgetary restrictions the Ministry of Health has been pruning its field services since the early 1960s. For instance as noted elsewhere (Simeonov, 1975:43) the proportion of infants cared for by Family Health Workers (then known as midwives) in their home visits had declined from an estimated 29 per cent in 1961 to 9 per cent in 1968. There is no reason to believe that the situation has improved since then, except for the estate sector where the state health care coverage increased since land reform and nationalization of estates in the 1970s. Inadequate budgetary

provisions became a common problem which adversely affected service delivery in the field and the maintenance of equipment. The only service that did not suffer much was family planning which became part of the official policy of the government in 1965, and had a large component of foreign assistance. Although this was integrated into the existing maternal and child health services, areas such as the immunization program which is a part of the MCH services, were not properly integrated with the program until recently. This led to an unbalanced growth in certain sectors in the health system.

There has also been a series of diarrhoea epidemics during the last few years indicating the need for concern about environmental and personal hygiene, illness control, availability and accessibility of sanitary toilets and better-quality water in adequate quantities. Despite the ambitious program for providing one million houses for the poor, and the provision of tube-wells to dry-zone areas where water was a problem, even by 1981 only 27 per cent of the households had any sanitary toilet while a third did not have any toilet at all. The 1981 census also showed that the proportion of households receiving drinking water from a protected well or from a pipe including street taps and tube wells was under 50 per cent (Department of Census and Statistics, 1986). There were particularly strong disparities between the regions in the availability and type of toilets and the source of drinking water.

1.8 Low Mortality with High Levels of Undernutrition: a Paradox

As a result of the changes in policy effected in the last few years the economy showed an improvement at the macro-level but the poorest groups in society suffered; the real purchasing power of the poor has been progressively eroded over the years as a result of the increasingly high prices including those of the basic food items. In the wake of rising prices failure to raise the value of food stamps means that the poor households which showed a tendency towards consuming less than the required calorie levels have been severely affected.

The level of mortality, particularly infant and child mortality, has been declining very rapidly after a period of stagnation (except for a rise in 1974) during which there

was fairly equitable income distribution and egalitarian food distribution supported by a network of price controls covering many basic necessities. During this period popular brands of infant milk were rationed and distributed for the needy through registered dealers: usually these were allocated to those who provided proof of a newborn child on the production of a copy of the birth certificate: an abstract for this purpose was issued by the registrar as soon as a birth was reported.

The rapidity of the infant mortality decline since 1977, with evidence of a high prevalence of childhood undernutrition, has raised problems of how to reconcile the low infant and child mortality with high malnutrition. According to one view, the registration of births and even early infant deaths is now not as complete as before the removal of the infant milk ration, which was previously an important incentive for early registration of a birth (Immerwahr and Pollack, 1983). This view was supported by evidence that in the more developed districts such as Colombo and Gampaha, and in the districts with substantial estate plantations where the registration of vital events is almost complete, the declines in the infant mortality rates were not rapid or did not occur at all. The declines were very marked in poor districts with a less literate, sparsely distributed population such as in the dry zone: this has been attributed to under registration rather than a true decline in the infant mortality rate.

The completeness of coverage in the statistical registration system, particularly of births and deaths, has deteriorated somewhat in recent years (Department of Census and Statistics, 1984), but it cannot be expected to be so great as to underestimate the real decline which took place in the period (Gaminiratne, 1984); besides, the subsidy offered for infant milk continued in the early 1980s; since then one type of milk food has been available in exchange for food stamps.

While some suspected the accuracy of infant mortality rates, others questioned the validity of estimated undernutrition, using anthropometric measurements and calorie consumption data. They hold the view that estimates derived by comparison with Western standards and arbitrarily determined cut-off points, produce exaggerated

prevalence rates (Abeyratne and Poleman, 1983), like the Sri Lanka Nutrition Status Survey of 1975-76 which showed that about 35 per cent of the pre-school population in rural Sri Lanka were undernourished, Whether those children who are shorter in stature compared to international standards, but do not have any other functional impairments, should be considered undernourished, was forcefully discussed by others who promoted the `small and healthy' hypothesis (Seckler, 1982). Aberatne and Poleman also found difficulty in interpreting the 1969-70 socio-economic data on consumption, which showed, on the basis of calorie inadequacies, that about 43 per cent of the poorest households (income under 200 rupees) in Sri Lanka are undernourished (Aberatne and Poleman, 1983:8). Higher prevalence rates arise, according to Aberatne and Poleman, due to rigidly following the international reference standards with rather arbitrary cut-off points. However, no alternative estimates were made nor has any rectification of the problem been proposed.

In the contemporary developing world most countries with a high prevalence of undernutrition also have a high level of infant and child mortality (Van Lerberghe, 1988). When a country is economically less developed, infant mortality and child mortality are particularly high and nutritional disorders directly or indirectly account for the bulk of the deaths in these ages (Bengoa, 1970). With economic development, technological advances in medical and other fields improve the living standards and the general nutritional levels of the people. Accordingly, the deaths due to and associated with nutritional causes will decline and the mortality among infants and children will fall (Bengoa, 1970). On the basis of this general pattern, and the evidence that under-nutrition and its relationship with subsequent mortality are shown in studies carried out in countries such as Bangladesh (Chen *et al.*, 1980; Bairagi *et al.*, 1985) and Papua-New Guinea (Heywood, 1982) where socio-economic class differentiation is high, the level of infant and child mortality is used as an indicator of undernutrition (Bengoa, 1970).

However, in countries where health and social development precedes economic development, such as Sri Lanka, mortality levels, infant and child mortality levels in

particular, can fall without a corresponding fall in morbidity. The deaths of children due to nutritional and related causes are minimized because of the improved health and medical care delivery system and the high levels of literacy of the population. In such a situation the infant and child mortality will not be a suitable indicator of undernutrition (Bengoa, 1970).

According to Caldwell (1986), one factor in the `miracle' of low mortality is the autonomy of women, which appears to be greater in Sri Lanka than in many parts of the region. Because of female autonomy women are able to make independent decisions about medical attention for their sick children and to use the available medical facilities more efficiently. A longitudinal survey of mothers and children carried out in some dry zone districts in Sri Lanka showed that mothers tended to use clinic services during pregnancy whether or not they were visited by Family Health Workers (FHW). Only 60 per cent of mothers were visited at least once during pregnancy by the FHW, while 88 per cent visited antenatal clinics (Meegama, Gaminiratne and Perera, 1988). Thus even in poorer areas the contacts with modern medical and health facilities are substantial. Even with deteriorating health services people tend to use them. Another important element, also connected with use of health care facilities, is the increasing coverage of the estate sector by the state health services, the pattern found after the land reform and nationalization of estates of 1972. Previously the provision of health care to people in the estate sector was the responsibility of the estates; as Meegama (1980) observed, the excessively high neonatal mortality in the estate sector was due mainly to the lack of antenatal services.

Another development related to infant survival in general and the nutrition of children in particular is the increase in family planning. There has been a tremendous increase in contraceptive use during the last two decades; the contraceptive prevalence rate for currently married women (15-49) increased, for the country as a whole, from 32 per cent in 1975 to 55 in 1982 (Gaminiratne, 1983). The current level of contraceptive prevalence is estimated to be slightly over 60 per cent. Although the prevalence of traditional methods is very high, the statistical evidence available so far has consistently

shown that an increasing proportion of couples desire to space their births and also to limit their family size.

The national family planning program from its inception concentrated on scientific methods for spacing birth, while sterilization facilities were also provided for those who desired them; lately sterilization has received greater attention and since 1982 a financial incentive was also offered for the acceptors of that method. Currently about 62 per cent of couples are using some form of contraception while one in every third couple, either husband or wife, is sterilized (Department of Census and Statistics, 1988).

Definite trends in the slow-down of population growth which began in 1963, except for the upward trend observed around 1980, continued over the years; the total fertility rate which stood at 5.0 in 1963 fell to 4.2 in 1971 and in the crisis year 1974, when the fertility level would be expected to be low, it reached 3.5. Since 1973 anaemic pregnant women and lactating mothers, undernourished infants (6-12 months) and pre-school children (13-72 months) have been given a food supplement known as `Thriposha' consisting of a fortified wheat-soya blend supplied by CARE (Cooperative for American Relief Everywhere), USA, now exclusively made of local grains. Thriposha is used as a food supplement with the objective of improving nutrition and reducing the incidence of low-birth-weight babies. In its peak distribution (1975-76) about 98 per cent of the targeted 300,000 beneficiaries were reached. Since then the proportions ultimately reached have declined but 60-70 per cent are normally covered (FNPPD, 1981:44, Table 5A.2).

The immunization program which began in 1961 also received a boost under the Expanded Program of Immunization (EPI) and became one of the health priorities with a target of full immunization by the year 1990. Currently, the present coverage of BCG exceeds 90 per cent and that for polio and triple antigen is about 80 per cent (Department of Census and Statistics, 1988, Boerma, *et al.*, 1990).

These positive factors together with the high literacy rates of the population may

have counteracted the adverse effects on the poor brought about by the adjustments in the food and welfare policies.

1.9 Empirical Research Findings on Socio-economic Aspects of Child Undernutrition

1.9.1 Socio-economic and environmental characteristics

The physical growth of a child is affected by two factors: genetic and environmental (Eveleth and Tanner, 1978). The maximum growth of a child is limited by the genetic potential; however, the limits are not reached by some children because of environmental and socio-economic influences. When the economic and environmental differentiation in a society is large and the level of development is low, human growth is heavily influenced by environmental factors; when socio-economic development is high, then the growth differences in the population are mainly influenced by genetic factors (Martorell, 1985).

If the growth pattern of children at specific ages is examined in terms of weight and height or length, weight gain will be found to be more rapid than the gain in length (WHO, 1986). Whether a child is growing satisfactorily in weight and length is determined by comparing the weight and length of the child with that of a normal child of that age; the normal child is taken from a suitable growth reference relevant to the population.

The general pattern found in many developing countries is that faltering of growth begins at about the third month or even earlier (Waterlow, 1980a; Carlson and Wardlaw, 1990). If the reference values used for comparison are applicable (see Chapter 3), then growth failure is caused by two factors,[3] both of which are environmental: inadequate food intake or absorption, and infections. In general, depending on the health of the mother and the child, breastmilk is the sole food recommended for the infant in the first 4-6 months; evidence relating to adequacy of

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[3] Growth failure can be due to genetic problems leading to a defective gut or lack of enzymes (i.e. lactose intolerance) which could also result in poor absorption of nutrients.

breastmilk is discussed in Chapter 6. The failure of growth in the very early months of life is thus indicative of inadequate food, mainly arising from the low milk output of the mother, which is a common feature in developing countries. The other factor responsible for evidence relating to growth failure is the presence of infections; these are more common during the period of introduction of weaning food. According to some studies the association between the two — infections during weaning and growth failure — is strong. Longitudinal studies in Punjab, India, by Wyon and Gordon (1962), in Gambia, by Rowland and McCallum (1977), and in Guatemala by Mata and others (1977) are particularly relevant.

In most cross-sectional studies the collection of accurate data on the prevalence of infectious diseases such as diarrhoea has not been feasible, partly because of under-reporting: not only because of ignorance or recall lapses but also because such disease conditions are so common that it is possible that only severe conditions are reported; partly because of the problems in the question design. In such circumstances the prevalence estimates of infections between socio-economic groups will give misleading results. As a result, as in the case of prospective studies, cross sectional data may not yield expected associations between socio-economic characteristics and the nutritional levels. As is shown in Chapter 4, prevalence of diarrhoea as reported by the SLDHS respondents appears to be low, and the observed differentials tend to show the reporting variations.

In most cases these two, nutrition and infections, act synergistically[4] to affect the growth of the child. These two factors in turn are determined by several other factors interwoven with the socio-economic fabric. Some influences are additive, where each factor affects the outcome independently, while many others affect it interactively. Their influences are thus complex.

Unsanitary environment is responsible for both these factors. Socio-economic and environmental factors are common to both inadequate food intake and infections,

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4 Combined effects of simultaneous implementation of elements give results much greater than the sum of effects of individual elements.

especially in a poor environment. As Mata and others (1977) show, children get sick because the supplementary foods given are contaminated. This is particularly true in environments where drinking water comes from an unsafe source, and there are no toilet facilities or the available facility is unsanitary. These tend to show a relationship with housing. Materials used for the construction of houses also can be used as an indicator of the socio-economic level of the inhabitants. The source of drinking water and toilet facilities also in most cases go together with the above characteristic of housing. In a study conducted in Honduras it was found that housing score (used as an index constructed using different characteristics) was strongly related to undernutrition (Martorrel, 1983 quoted in Martorrel, 1985). In the absence of data on income or other details to assess the socio-economic conditions of the household, housing and other related characteristics such as toilet facilities and source of drinking water, can be used as proxies for environmental conditions.

Undernutrition is more common in areas with a low level of economic development and in developed countries among poor communities: the root of under-nutrition is poverty. Thus many studies find associations with variables which best describe poverty in particular settings. In some studies education of the mother and father was used as proxy for the modernization and socio-economic status of the household, because the educated mother behaves differently in child rearing and care: she may be more knowledgeable about food hygiene and is more quick to act in the case of sickness. She is more likely to have a higher social status and to be employed in the modernized sector. The educated mother also has more influence than a less educated woman in decision-making, particularly in the allocation of resources at the household level (Caldwell, 1979). Accordingly, studies conducted in several parts of the world have found a strong negative association between maternal education and child undernutrition, for instance, in India, the work of Wolfe and Behrman (1982), and in Bangladesh by Bairagi (1980). However this relationship is not consistently found in other studies. In Nepal, Martorell, Leslie, and Moock (1984) did not find a significant statistical association between the mother's educational level and the nutritional status

of children, nor did Wray and Aguirre (1969) in Candelaria, Colombia. An analysis of an in-depth study carried out in a hill country district (Kandy) in Sri Lanka also found the influence of the mother's formal education to be non-significant in the observed nutritional status of children (Edirisinghe and Hettiarachchi, 1985). In countries such as Sri Lanka where unemployment is high particularly among the educated, mother's education alone may not be a strong predictor of the socio-economic level of a household.

Several studies, on the other hand, resorted to other indicators using characteristics such as housing, education of the parents or wealth, in order to differentiate the households according to a socio-economic scale and then to examine the nutritional status of children in those categories. In rural Jamaica, for instance, an index of the socio-economic status of the family was devised using characteristics such as housing, educational attainments and employment of parent: a strong positive association was found between the socio-economic status of the family and the nutritional status of the children (Richardson, 1974). In Honduras Martorell (1985) found a housing score based on an index using various characteristics of housing to be strongly associated with undernutrition, with low levels of undernutrition among children in better housing. Tomkins and others (1986) reported in urban Gambia significant differentials in child nutrition between traditional houses and modern houses (European style).

In Sri Lanka, it has been found that certain characteristics of the house such as the type of floor, whether mud or cement, is a reasonably good indicator of the poverty of its inhabitants (cited in Gunatilleke, 1989). A longitudinal study of mothers and children carried out in the dry zone of Sri Lanka revealed perinatal mortality to be significantly higher among those living in houses with mud floors than those with cement floors; 31.3 and 24.3 per 1000 births respectively. The neonatal mortality rate also differed significantly and was 18.8 per 1000 live births for children in houses with mud floors, 11.0 per 1000 live births in houses with cement floors (Meegama and Gaminiratne, 1986).

Mostly related to housing, several studies have shown sanitation variables to exert a statistically significant influence on the nutritional status of children. A study in Lebanon by Kanawati and McLaren (1973) found through the index of thriving (a single summary measure of nutritional status using anthropometric measurements of weight, height, head and midarm circumference for each child) that thriving children are more likely than the others to come from houses with toilet facility inside the unit, `well kept' houses with clean water and with separate kitchens (Kanawati and McLaren, 1973:573). Most of the evidence available on the association between water supply and sanitation, and child health, is concerned with the infectious diseases, mainly diarrhoea (Feachem, 1985). Relating housing characteristics, source of water supply and availability of latrines, reported in the national population census of 1971 to the infant mortality registered in each of the administrative districts, Patel (1980, 1981) found that low mortality in the districts was associated with well water while slightly higher infant mortality was associated with tap water. Patel attributed this anomaly to the possibility of contamination of tap water, which according to one review is not supported by evidence on quality of water from different sources (Feachem, 1985).

Two studies, both using SLWFS data examined the relationship of various environmental exposure variables with infant mortality: one study by Meegama (1980) found a strong association between toilet facilities and infant and child mortality, with households with no toilets having higher mortality rates among the infants and children than those with any toilet. Infant and child mortality was found to be low in households having a sanitary toilet. (See Also Trussell and Hammerslough, 1983). Strangely, this association was found even in the neonatal period where deaths are mainly determined by events *in utero* and the conditions surrounding childbirth. There could be an underlying socio-economic or wealth effect in this association.

However, Meegama did not find any statistically significant association between water supply and infant and child mortality. This may be due to the fact that the current source of water supply was assumed to have prevailed in the past. For some women this period covers over a quarter of a century, during which period there has been much

change in the water supply sources. Perhaps the association of water supply may be more relevant with the more recent mortality and nutritional stutus of children. In a rural area of Northern Nigeria, the drinking water supply was found to be a major influence on nutrition through its effects on diarrhoeal infections (Tomkins *et al.*, 1978). This association was found with low weight for height, but not low height for age. This leads to an important point in the indicators of undernutrition: in order to examine socio-economic influence on nutrition there should be a distinction between low height for age and low weight for height, as they represent different types of undernutrition: this aspect is discussed in Chapter 4.

1.9.2 Demographic characteristics

While socio-economic characteristics show an important relationship with the nutritional status of children their influence is normally revealed through other biological and behavioural characteristics of the population. The characteristics relating to mother and child, such as maternal age, birth order (or alternatively family size), birth interval, age and sex of the child also form a part of the complex web of the nutritional status. The sex of the child has also been shown to be a strong predictor of nutritional status of children in countries where there is a sex bias in favour of boys. A study in Bangladesh found evidence of discrimination against girls in the allocation of food within the household (Chen *et al.*, 1980:55; Bhuiya *et al.*, 1986), while in several other countries such as in India (Khan *et al.*, 1989) higher mortality among girls than boys implies that there could be a bias, whether deliberate or not, against daughters. In Pakistan Sabir and Ebrahim; (1984) reported evidence of sex differentials in growth in favour of boys and concluded that there is a strong bias against daughters. In Sri Lanka until recently girls had higher mortality than boys and if there is a bias towards any sex in relation to breastfeeding and weaning or care it should be reflected in the observed nutritional levels of children.

Studies have often shown that the association between family size and child nutrition is negative. In the Candelaria study, Wray and Aguirre (1969) found that the

proportion of children undernourished increased significantly with family size; children undernourished increased from 38 per cent among children in families with less than five children to 44 per cent among those with six or more children. Similar findings were reported in other studies (Christiansen, Mora, and Herrera, 1975; Marchione and Prior, 1980).

An Inter-American Investigation of mortality in childhood reported birth order, maternal age and birth interval as the principal factors affecting child survival in Latin American countries (Puffer and Serrano, 1973, 1975). Both maternal age and birth order were consistently shown to be associated with neonatal mortality: in four of the five countries studied maternal age showed a U-shaped pattern with neonatal mortality, with lowest mortality being in the 20-29 age groups (Puffer and Serrano, 1973). A much stronger association was found between maternal age and infant immaturity: the pattern was similar to that of neonatal mortality. The researchers reported that in most of the field sites the association of birth order and neonatal mortality and immaturity was found to be consistently positive and the greatest risk was associated with birth order five or higher. The effect of maternal age and birth order in general are interrelated: the younger the woman at the birth of her child, the more likely it is to be of low parity and vice versa. If a woman gives birth to children at a very young age, if she has reached high parity at an early age, then it is likely that the health and nutrition of both the child and the mother are affected. This process implies an important characteristic related to child nutrition: length of interval between births.

Research carried out in different parts of the world has consistently shown that birth spacing has a strong influence on the survival of children and the health of the mother (Pebley and Millman, 1986). The effects of having a short birth interval on the health, nutrition and survival of the children have long been known to traditional cultures (Morley, 1977b; Gray, 1981). Wray and Aguirre (1969:91) note that the name `Kwashiorkor' means in an African tribal language `the disease of the deposed baby when the next one is born' and this implies that the earlier the weaning the more the infant will suffer. Wray reviewed the available evidence examining the relationship

between birth interval length and child health, nutrition and survival of children. Except for a few studies such as the one by Gordon and Wyon (1962) in Punjab, India, and Wray and his colleagues' (1969) study in Candelaria, Colombia, these findings were mainly related to developed countries.

Evidence on the association between birth interval length and the survival status of children has increasingly been available in developing countries, particularly since the World Fertility Survey global program of research initiated in the early 1970s. The results of the survey series have almost consistently shown that when the interval between two births in a family is short, say less than two years, both children, born at the beginning and the end of the interval, carries health hazards and have a higher risk of dying in infancy and early childhood. It was shown that a longer interval between births will lead to the enhanced survival of children (Maine and McNamara, 1985; Wray, 1971).

Although the results are consistent, the mechanism by which the interval length between births and health, nutrition and mortality operates is not well understood (Winikoff, 1983; Thapa, Short and Potts, 1988). There are three hypotheses put forward in explaining the mechanism. One hypothesis relates to the mother's health; it assumes that there is a deterioration of health because of having two births too early, without having sufficient time for the reproductive apparatus to recover from the earlier child-birth. In such circumstances the outcome of a birth will be small-for-date babies (Haaga, 1989). Cycles of pregnancies together with heavy physical work and prolonged breastfeeding deplete the maternal resources ultimately resulting in the low birth weight of the babies. This condition has been described as maternal depletion syndrome, and was first observed in the New Guinea Highlands by Jelliffe and Maddocks (1964:435). The syndrome was used to describe weight loss, reduced quality and quantity of breast milk, and health problems associated with repeated pregnancies and extended breast-feeding, but has now been used without reference to the workload (Winikoff and Castle, 1987:1).

Another explanation relates to the total family size and birth order of the child; if two children are born too soon they are too close to each other in terms of age, both of them depend on the mother for care and love, so there is competition for the resources, time and attention from the mother, affecting the health and growth of both the children. The arrival of a new baby will necessarily deprive the older sibling of the attention of the mother. Since breastfeeding is stopped when pregnant while nursing, this implies a quick weaning of the older child; this can affect the health and nutrition of the child through weaning diarrhoea (Gordon, Chitkatu and Wyon, 1963). The third explanation is cross-infections: having more than one child of similar age in the household increases the chances of contracting infectious diseases and increases their severity (Thapa and Retherford, 1982). In his studies on measles mortality Aaby found mortality from measles to be greater among households with multiple cases of the infection than in houses with single cases (Aaby, 1989), and he suggests that when there are children of similar ages sleeping in the household, the disease is more likely to spread. A disease like measles is shown to particularly affect the nutritional status of children (Morley, 1973).

Hobcraft, McDonald and Rutstein (1985) examined the WFS data relating to 35 countries to assess the effects of birth interval on infant and child mortality. Infant and child mortality was analysed according to the broad age at death controlling for other factors such as maternal age, birth order and sex of the child. They reported that if a birth takes place in less than two years from the first birth, there is an elevated risk of dying in infancy and in childhood. The risk of dying is found to be high during infancy. Hobcraft *et al.* attributed the excessive risk of infant deaths mainly to maternal depletion and `competition effect', and the mortality risks in the later periods to abrupt weaning presumably associated with the new pregnancy. They also noted that the risk of dying of the child is higher even when the previous child is dead. This finding, according to Pebley and Elo (1989), runs contrary to the observation of the competition effect, which Hobcraft and colleagues speculated to be the primary cause of short birth interval effect on high mortality risks. Studies in several other countries showed that

the survival status of the preceding child is closely associated with the high mortality risks of the index child (Hull and Gubhaju, 1986) while the survival status of the succeeding birth was also associated with higher mortality of the index child in other studies (Majumder, 1989: Koenig, *et al.*, 1990; Retherford *et al.*, 1989).

Using the Pakistan Fertility Survey, Cleland and Sathar (1984) observed similar mortality risks associated with short birth intervals. Infant mortality among children born within a space of 18 months was more than twice that of those after a long interval. This association remained significant after controlling for the previous birth interval. Cleland and Sathar did not find any evidence of a competition effect and attributed the high mortality risks to premature weaning. Higher mortality risks with short birth intervals have been reported.

Pebley and DaVanzo (1988) using data from Guatemala and Malaysia, attempted to examine the hypothesis that maternal depletion is one of the causal mechanisms through which birth interval affects health and survival of children. They examined the weight of mother at conception, weight gain during pregnancy and birthweight as possible indices of maternal depletion and did not find much evidence to support the hypothesis. They observed that women with short birth intervals tend to weight more at conception (contrary to the expectations) gain less weight during pregnancy, and bore children with similar weights to those of the women with long birth previous birth intervals (Pebley and DaVanzo, 1988:45-46).

While most of the studies concern birth spacing and infant and child mortality, there are a few studies which examine the effects of birth spacing on child nutrition. In the Candelaria study Wray and Aguirre (1969) found that the percentage malnourished did not show much variation under 24 months, but after 36 months the proportion undernourished declined significantly when the birth interval length was at least three years. A study in a rural area in Kenya by Boerma and Van Vianen (1984) showed that children born within an interval of less than two years did not show any significant risks of mortality or growth retardation in the first year, but there were substantial risks of

growth retardation during 15-18 months of age and no significant difference thereafter. A study carried out in Nigeria by Doyle and others (1978) did not find a significant difference in growth in children between the short and long birth intervals but found strong birth order effect on the long intervals.

Another study in Senegal examined the association between birth intervals and the nutritional status of children using height for age as the indicator of nutritional status. According to them, any effect of birth interval on nutritional status of children should be a long-term rather than a short-term condition (Goldburg and M'Bodji, 1985:68). They found, for the total study population and for most of its subgroups, that this relationship was negative: the proportion of children with low height for age declined from 49 to 36 per cent when the interval since the previous live birth increased. This finding was common to all except higher socio-economic groups, high-parity mothers, and some ethnic groups. Mothers in high socio-economic groups have adequate means to support the infant's development despite the short interval between births; they are also likely to use health care services more efficiently. Goldburg and M'Bodji speculated that it is maternal depletion rather than the competition between siblings which is more influential in low height-for-age. They found very long succeeding interval and poor nutritional status to be positively correlated, and are of the opinion that long intervals for poor groups are a result of poor health, and because of nutritional disorders their babies are also poorly nourished.

There are also studies which examined the effects of birth interval length on intra-uterine growth and birthweight; Fortney and Higgins (1984) examined the effects on perinatal mortality and birthweight of a large sample of singleton births. The analysis was restricted to women whose previously born child was living at the time of the new pregnancy. Fortney and Higgins found that compared to long intervals, with short intervals (9-12 months) between the last birth and the current pregnancy, the risk of intra-uterine growth retardation or low birth weight increased significantly. A case control study carried out in Brazil, comparing intra-uterine growth retardation and low birth weight with normal babies in relation to inter-pregnancy interval, had similar

results (Ferraz *et al.*, 1988).

Although the exact mechanism of the influence is not yet clear-cut, on the evidence available the deleterious effects of short birth or pregnancy intervals on intra-uterine growth, birthweight, health and nutrition of the child and child mortality are overwhelming. When reviewing the studies examining the empirical evidence of strong association between birth interval length and infant mortality, Potter (1988) reminded researchers about the possible problems relating to data: the strong association found in the studies on the above could be a result of the omission of deceased children (which makes the birth interval longer) and the misreporting of dates in the retrospective birth or pregnancy histories. Potter's other point is the possibility of confounding factors in the association; he directed the attention to the empirical evidence of the association between the use of health care services and breastfeeding, contraceptive use and child survival in general. The former two are important determinants of birth interval length. Accordingly, Potter argued that the strength of the association observed in the studies could be spurious. Palloni and Millman (1986), however, attempted to examine the relationship of inter-birth intervals with infant and child mortality by controlling for the duration of breastfeeding; but the inclusion of breastfeeding interval in the analysis did not alter the impact of the birth spacing on child survival. In Matlab (Bangladesh) longitudinal data Shahidullah (1990) found that duration of unsupplemented breast-feeding, rather than total breastfeeding duration significantly increasing the survival chances of children in the early ages.

1.9.3 Breastfeeding and food supplementation

In the association between birth interval length and child nutrition, breastfeeding exerts a major influence. Although breastfeeding is the major source of nutrients for the newborn it also has the effect of extending the anovulatory period, lengthening the duration between the birth of the child and the next conception. Jelliffe (1955) has reported that mothers in many cultures use breastfeeding as a means of delaying the next conception. The World Health Organization expert committee on maternal and

child health recognized these dual effects of breastfeeding, and recommended that breastfeeding should be encouraged for a long period to help maintain the health of the child and the mother (WHO, 1961). The effect is particularly strong when breast-feeding is not supplemented using bottles with nipples as the contraceptive effects of breastfeeding is related to the frequancy of suckling.

Studies examining the effect of breastfeeding on child survival in general and health and growth performance in particular, have been made available in countries with different development levels for many years. Several studies reported that growth performances of the exclusively breastfed babies were better than among those fed with alternative food (Gordon and Wyon, 1963; Jayasuriya and Soysa, 1974; Cunningham, 1979). The problem often encountered in these studies is that these observations are mostly based on a selected group of children who were attending clinics, or hospital trials centred on newborns with certain birth defects or low birth weight problems. In such cases it is hard to determine the causal factor in the growth failure or the poor health: the breastfed babies may have been the ones with good health and growth, and the bottlefed babies may have been moved from breastfeeding as a result of health problems (Saulis, 1984). A task-force on infant feeding reviewed the evidence available to them and found several problems in the interpretation, affecting the reliability of the findings (Seward and Serdula, 1984). Among the problems they observed were: most studies did not provide the procedural guide-lines followed and the details such as the sampling; the small samples used in the studies, which are subject to unspecified biases; the inability to control for confounding factors.

Feeding patterns, on the other hand, change according to the age of the child. In the first three months mothers are encouraged to breastfeed without introducing any supplementary food. From 4 to 6 months semi-solid foods are introduced in addition to breastmilk, after which solids are introduced gradually until the child is completely weaned from breastmilk to family food. The breastfeeding effect on child growth therefore can be mainly seen in the exclusively breastfeeding period: this period roughly covers the first six months of infancy (Millman and Palloni, 1984). The

problem of assessing breastfeeding effects on growth during this period is that the growth is affected by factors other than the feeding process: as is the case in Sri Lanka, incidence of low-birth-weight babies is high in many developing countries. A low birth weight baby may not be able to recover its full growth potential (Seward and Serdula, 1984). Even if catch-up growth is possible, it will take a relatively long period for recovery. Also, while breastfeeding mothers normally introduce other foods in very small quantities, although the quantity is small it can lead to diarrhoea, which adversely affects the growth of the child.

After six months the pattern and frequency of breastfeeding will be different and food supplements are introduced in different quantities. The timing of introduction of food supplements will affect the production of milk (discussion follows in Chapter 6). When such foods are introduced the child is more likely to suffer from infections, mainly diarrhoea and enteritis. Although breastfeeding and weaning are important factors affecting the physical growth of a child, their real impact can be overshadowed by the above factors.

1.9.4 Health care behaviour

As discussed earlier, the expansion of medical and health care facilities to most of Sri Lanka was one of the factors responsible for the low mortality observed in the country. From the point of view of children's nutrition the health practices of mothers are important such as to the extent to which pregnant women used the available health care facilities during the antenatal period, delivery and the postnatal period. These facilities include pregnancy checks at the clinics and visits by the Family Health Workers, because any high risk to mothers in terms of nutrition and mortality, can be identified at this stage for follow-up action and treatment. Anaemic women can be identified in advance and can be treated accordingly. In Sri Lanka nutritionally vulnerable groups, pregnant and lactating mothers, are given Thriposha, pre-cooked food fortified with vitamins, for children and mothers identified as nutritionally deficient. Those mothers who attend clinics and are visited by the FHW, are expected to receive advice on food

intake and vitamin supplements during pregnancy and lactation, and instructions on breastfeeding and weaning, family planning and immunization of children.

Infections affect the nutritional levels of children by altering the metabolism and absorption, and reducing food intake. Because of these two aspects infections and malnutrition are said to have synergistic effects (Scrimshaw *et al.*, 1968). There is evidence that children suffering from diarrhoea had retarded or low growth (Poskitt, 1972; Rowland *et al.*, 1977). Respiratory infections, however, do not show such clear associations with nutrition. Probably their influence, if any, may be mediated by low level of food intake during illness. It has been found that whooping cough has had an influence on the poor growth leading to marasmus (Morley, 1973).

Although immunization of children does not have a direct influence on nutritional status, it has the advantage of preventing of common diseases such as measles, tuberculosis, diphtheria and whooping cough, which directly or indirectly lower the nutritional status and increase the general susceptibility of the children (Morley, 1973). These characteristics are also relevant in the study of child nutrition, although the use of such services is determined by the socio-economic and environmental characteristics of the population.

1.10 Organization of the Research Study

The remainder of the research study is organized into seven chapters: Chapter 2 gives a description of the survey, the sample design, questionnaire and a broad evaluation of data quality with special focus on the data relating to children whose anthropometric data are available, and their mothers. Chapter 3 gives a brief discussion on the key issues relating to the assessment of child nutrition using anthropometric data of weight and height, or length. It also describes the indicators of nutrition, the selection of suitable growth standards, the framework of analysis and the main statistical methodology adopted in the analysis of child undernutrition. Chapter 4 gives the main socio-economic and demographic characteristics of the population and their interrelationships. Assessment of the nutritional status of the study population, their

broad trends and main socio-economic variations are discussed in Chapter 5. Chapter 6 discusses the patterns of breastfeeding and weaning and their socio-economic variations while Chapter 7 examines the socio-economic and behavioural influence on under-nutrition. The final chapter discusses the main findings of the research and highlights the relevant policy issues relating to undernutrition of children.

Chapter 2

Source of Data and Data Quality

2.1 Introduction

Sri Lanka is fortunate in having had a regular series of population censuses since 1871 and a more than century-old system of vital registration (Gaminiratne, 1989). Perhaps the most important and widely analysed data base in the country for the study of recent socio-economic differentials in infant and child mortality, nuptiality, fertility and contraceptive knowledge and practice has been the Sri Lanka component of the World Fertility Survey (SLWFS) of 1975. The SLWFS was the first field survey of this magnitude carried out by the Sri Lanka Department of Census and Statistics (DCS). Since then DCS has carried out several surveys of demographic significance: Determinants of Fertility Change 1979; Contraceptive Prevalence Survey (SLCPS) 1982; Sri Lanka Contraceptive Survey of 1985 (follow-up Survey of SLCPS respondents); and more recently, the Sri Lanka Demographic and Health Survey (SLDHS). The data for this study are derived exclusively from the SLDHS which was conducted during the period January-April, 1987.

2.2 Demographic and Health Surveys Program

The Demographic and Health Surveys program, of which SLDHS is a component, was undertaken by the Institute for Resource Development (IRD) of Westinghouse (now Macro) USA with support from the Population Council since 1984. It is an international program of research designed mainly to update and expand the international demographic and family planning data base collected by the WFS and CPS programs (Lapham and Westoff, 1986; Fisher and Way, 1988). The DHS program, unlike the WFS and CPS survey series, has novel features: for example the collection of information on topics relevant to assessing maternal and child health, especially the data on length and weight measurements of children, generally 3 months to 36 months old.

2.3 The Questionnaire

The DHS program developed two versions of questionnaires, core `A' and core `B', to be used in participating countries, core `A', for countries with a high contraceptive prevalence and the other for countries with low prevalence. SLDHS used the `A' version of the questionnaire with some additional questions and topics of national relevance. The SLDHS questionnaire had three parts: household, individual and anthropometric. The household part contained a listing of all members of the household including those temporarily absent and visitors present. For each of the members listed in the household schedule information on sex, residential type and marital status was collected. From these data eligible respondents were identified for detailed interviews: they were the `ever married women 15-49 years old, who slept the previous night in the household'.

2.4 Questionnaire Content

The questionnaire of the SLDHS and the main items of information collected are briefly as follows:

(a) background characteristics of the respondent: age, education, ethnicity, religion, residence and migration status, source of water supply, availability and type of toilets, exposure to mass media;

(b) reproduction: cumulative fertility, number and sex of dead children, complete live birth history and current pregnancy status;

(c) contraception: knowledge and practice;

(d) prenatal care and breastfeeding, care during pregnancy and delivery, breastfeeding and food supplements, immunization of children (living children), prevalence of diarrhoea and the use of Oral Rehydration Salts; these were collected from children born five years before the survey;

(e) marriage: current marital status, number of times married, age at marriage, sexual activity, reasons for non-use of contraception;

(f) fertility preferences: desired and ideal family size, desired timing of next birth;

(g) husband's background and work pattern; and

(h) anthropometric measurements (weight and length of children aged 3 months and 36 months).

2.5 Selection of Sample

When the DHS survey was planned several meetings with data users were held, and at those meetings it was strongly suggested by some users that the SLDHS should, as far as possible, provide estimates of fertility, contraceptive use, infant and child mortality, undernutrition and immunization coverage according to levels smaller than the residential types (urban, rural and estate sectors). Three options were available to meet this requirement; one was to provide estimates by administrative districts. They numbered 24 in 1981 and it was found necessary to cover a large sample of about 24,000 households to obtain reliable estimates at district level. The resources and time constraints obviously did not favour this.

The next option was to make the estimates for nine provinces. At the time of the SLDHS planning (before the provincial councils were set up) the provinces were not effective administrative units. Besides, the provinces cannot be considered homogeneous units, and consequently a provincial classification was considered unsuitable for stratification. The only option then was to use the socio-economic zonal classification used by the DCS in earlier surveys, the Socio-economic Survey of 1969-70 and SLWFS 1975.

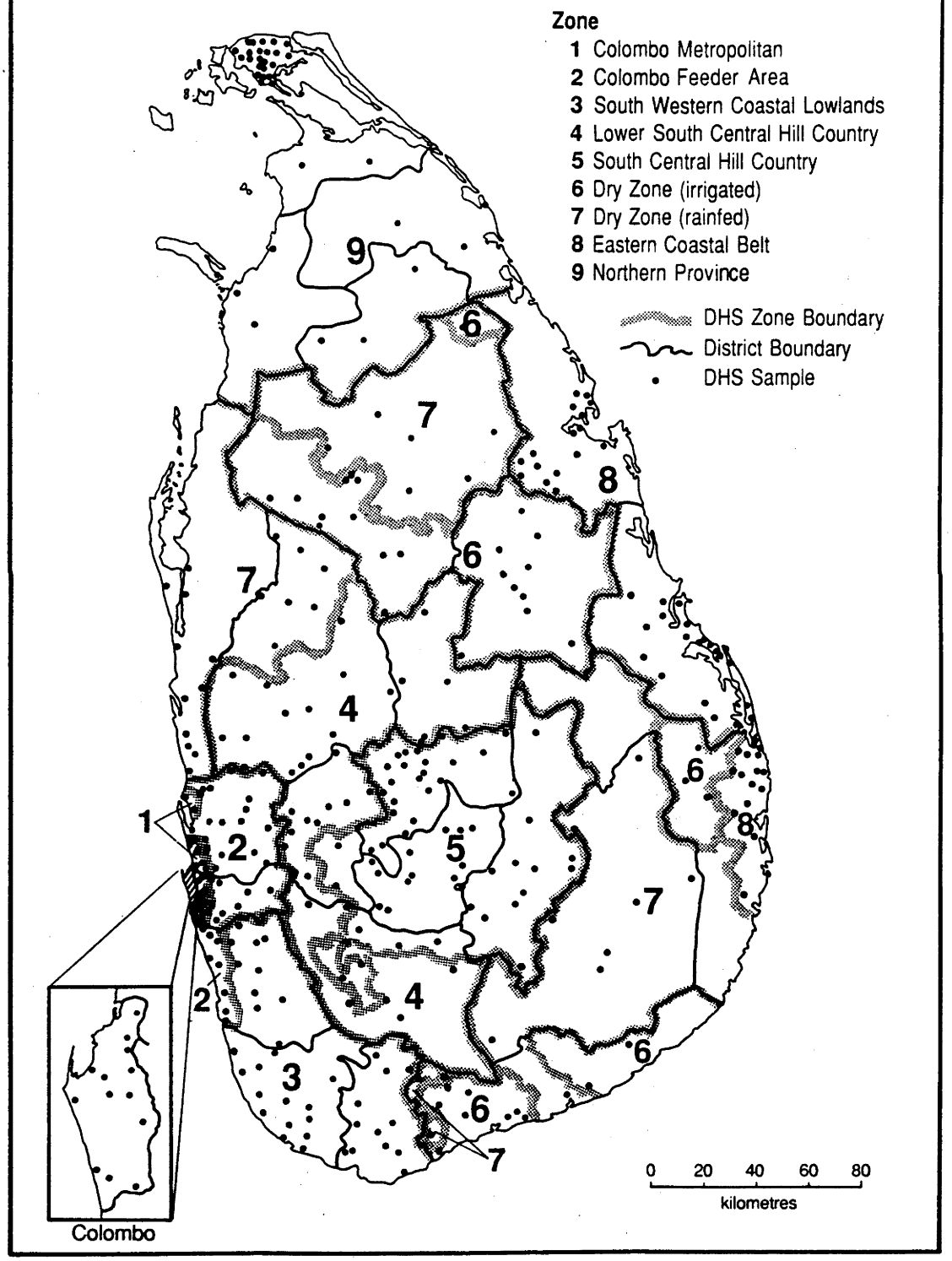
2.5.1 Classification of socio-economic zones

For the purpose of these surveys of the DCS, the country was divided into six zones based on climatic, cultural, and development criteria (Department of Census and Statistics, 1978:20-21). In several respects, the SLWFS socio-economic classification was found to be inadequate for the SLDHS; there were several changes in the level of development and urbanization that had taken place in the zones since the conclusion of

Map 2.1

SRI LANKA

Socioeconomic Zones and
Distribution of SLDHS Survey Blocks



the SLWFS. The SLWFS data analysts also often encountered problems of inadequate number of cases for detailed study of certain population subgroups (Meegama, 1982). Among these groups the estate population of Indian origin assumed great importance particularly for policy interventions, accordingly, it was felt that further refinements to the existing zonal classification were needed for the SLDHS.

After careful consideration of national data requirements, SLWFS experience and the socio-economic changes which had taken place in the districts, the following classification was devised for SLDHS.[1]

(i) Zone 1 was centred on Colombo, the capital city, and covers its immediate suburbs with high population concentration. To the north of Colombo this zone includes all peripheral towns up to Negombo, in Gampaha district. To the south it extends over the coastal belt to Kalutara. This is a zone with a high degree of heterogeneity; the distribution of population has several unique characteristics. Thus it includes SLWFS zone 1 and a part of SLWFS zone 2; this is the most urbanized region of the country. It also has a mixture of populations belonging to different ethnic, religious and cultural groups. As SLWFS described the then zone 1:

> the professionals, businessmen, and the more affluent sections of the population in the city of Colombo are concentrated in certain parts of the city. The slum dwellers are [mostly] confined to certain other areas and the middle classes have their own confines within the city. There is a fairly high degree of racial and religious segregation as well, Sri Lanka Tamils in one area and the Moors in another. Population in some areas is predominantly Catholic (Department of Census and Statistics, 1978:22).

(ii) Zone 2 covers the rest of the Colombo and Gampaha districts and contains all coastal towns to Galle district through Kalutara. These are the feeder areas of Colombo. It has a fairly high proportion of suburban population with relatively high literacy levels. This zone also for many purposes can be regarded as a developed region of the country.

(iii) Zone 3 includes the south-western lowlands and covers the rural parts of

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1 See map for the demarcation of SLDHS zones and the distribution of administrative districts.

Kalutara district and the whole of Galle and Matara districts. It includes developed areas along the coastal belt, some rubber and tea plantations with sizeable labour populations and rural agriculturalists, most of whom are paddy farmers and rubber and tea small-holders.

(iv) The districts of Kurunegala, Matale, and the largely non-estate plantation regions of Kegalle and Ratnapura districts come under Zone 4. This area covers SLWFS zone 6 excluding the major estate plantation regions but has some representation of estate population.

(v) Zone 5 comprises the south central hill country districts with a heavy concentration of estate plantations where Indian Tamils form the majority of the labour population. This zone corresponds to part of zone 5 of the SLWFS classification.

(vi) Zone 6 was carved out of SLWFS zone 3 by taking the irrigated parts of the dry zone. Compared to the rest of the dry zone this is generally a developed area.

(vii) Zone 7 thus covers the rainfed farming areas of the dry zone and is the least developed area in the country.

(viii) Zone 8 covers the eastern coastal belt with a high concentration of Sri Lankan Tamils and Moors.

(ix) Zone 9 is the northern province with an overwhelming majority of Sri Lankan Tamils. The latter two zones are identical with the SLWFS classification of zones 4 and 5. Except for the two zones in the dry zone (6 and 7) all zones are contiguous.

2.5.2 Sampling procedure

Details of the SLDHS sampling procedures are given elsewhere (Department of Census and Statistics, 1988:7-9) and only a brief summary is given here. The SLDHS sample was stratified by the socio-economic zones, and the 1981 Census Block Records (enumerator areas) partly updated in 1986, were used as the sampling frame. For the

purpose of the sample, each zone was further stratified by urban, rural, and estate sectors depending on their presence in the zone. A multi-stage sampling (two or three depending on the stratum) was used.

In general the sample selection was undertaken as follows: in the first stage a stratified sample of primary sampling units (PSUs) were selected according to probability proportional to the size (PPS). Within each zone the PSUs selected were allocated proportionately between the sectors. In the second stage two census blocks were selected systematically according to the PPS. In the third stage the housing units were selected with inverse PPS.

The sample was equally allocated between the socio-economic zones except zone 5 which was over-sampled to capture a substantial number of the estate population. Accordingly, a target of 1350 individual interviews was fixed for this zone and 900 completed interviews from each were planned for the rest of the zones. Owing to the political disturbances, the survey work in zones 8 and 9 was abandoned; therefore the SLDHS data file is confined to zones 1-7.

Overall, the SLDHS listed 8119 households in seven zones of which 96.3 per cent were successfully covered in the household schedule. A total of 6170 were finally identified for detailed interviewing and the actual number of ever-married women interviewed was 5865 with a response rate of 95.1 per cent.

2.6 Recruitment and Training of Field Staff

Females were used as interviewers, and weight and length measurements were done by males; all were permanent officers of the DCS. In terms of educational level, interviewers had a minimum of 12 years of schooling (at least G.C.E. `A' Level); more than half were university graduates. In terms of experience, more than half had experience in the previous surveys and had participated in at least three of the four major surveys referred to in section 2.1. However, 46 per cent of the interviewers, who were newly recruited Statistical Investigators of the DCS, had no experience.

Supervisors and interviewers were trained at the headquarters. The training program for both supervisors and interviewers lasted for ten days and included classroom training, field practice and field editing. Supervisors were given additional training covering their administrative, supervisory, quality control and co-ordinating roles and functions. The survey training was conducted by staff of the DCS who were involved in the development of the survey work, assisted by the staff of IRD/Westinghouse. After training, each interviewer and supervisor was required to complete three questionnaires in the field in an area outside the PSUs and these were later reviewed by the headquarters staff and were edited by the interviewers themselves. For those who were participating in a survey for the first time, special arrangements were made: they were paired with experienced interviewers and initially, they were asked to observe the conduct of interviews by the senior interviewer and to record the responses separately in the questionnaires provided. These were later matched with those of the experienced interviewers and then necessary briefings were made. The first few interviews of new interviewers were observed by the supervisory staff and their day-to-day performances were particularly checked. Only when it was proved that they could do the interviews independently and successfully were they sent to the field; and others were left at the headquarters for coding and editing work.

Interviewers were formed into eight teams, each comprising a supervisor, five interviewers, a measurer and an assistant measurer. However, after completion of survey work in zones 1 and 2 two teams were retained at headquarters leaving the survey work in other zones for the remaining six teams. One of the team consisted exclusively of Tamil-speaking persons and was used in the estates and other areas where Tamil-speaking respondents were concentrated.

2.7 Training of Measurers

A thorough training of measurers was necessary as none of the trainees had any previous experience in anthropometric measurements; an intensive training program was designed for them with the help of a trainer provided by the IRD. A classroom

briefing was given for two days; it included lectures on general anthropometry, techniques of weighing and measuring length, accurate measurement and recording, and demonstrations of equipment handling. The main focus of the program, was practical training which was provided with infants and toddlers in two children's homes located in Colombo.

This training lasted for five to six days; at the end of training a standardization test was undertaken when each trainee was required to weigh and measure the length of ten children, each on two different occasions. The same children were measured twice by the trainer. The average length and weight of children as recorded by the trainees were later compared with those by the trainer for accuracy and precision; on the basis of the results, the trainees were graded and those who did not perform satisfactorily in the test were given additional training. The trainees found to be satisfactory were appointed as chief measurers; the others were employed to assist them. Before they were attached to survey teams they were given further training in the field. Their actual work in the field was also closely supervised in the first few days of field work; during these days each measurer and assistant measurer was briefed at the headquarters about their performance the previous day before they proceeded to the field the following morning.

2.8 Data Processing

Each evening the completed schedules of the day were edited in the field by the members of the survey team for general consistency and for missing data in respect of key items of the questionnaire. For any questionnaire with unresolved inconsistencies supervisors were required to send the interviewer back for clarification and correction. The formal editing and coding of questionnaires were done at the headquarters by the investigators who were not sent to the field after training and those retained in Colombo after the completion of fieldwork in zones 1 and 2. Micro computers were used to process the data. The Integrated System for Survey Analysis (ISSA) was used for machine editing and imputation of variables.

2.9 Data Quality

A thorough evaluation of SLDHS data collected at the household enumeration and the individual interviews is not made here but an attempt is made to assess the quality of the data on certain items on which the present research is primarily based. The analysis here is mainly confined to the characteristics of the children whose weight and length measurements are available, and of their mothers. A brief comment on data on diarrhoeal morbidity and Supplementary food are given in A.8.1 (Appendix).

2.9.1 The study Population

The SLDHS covered a total of 5865 ever-married women in the 15-49 age group from a representative sample while the anthropometric data pertained to children aged 3 to 36 months, their mothers, and households selected from the SLDHS sample. This study population is an unbiased sample of children who were born to SLDHS respondents within a specified period of time: 3 months to 36 months before the survey.

It is of interest to examine very briefly basic characteristics of the population who have been included in the research (anthropometric sample) and those who have been excluded. Comparative figures on the basic characteristics of the women in the anthropometric sample and the rest of the sample are shown in Table 2.1.

As expected, women in the anthropometric sample are younger than the rest of the women; a little over half of them are under the age of 35, while about a quarter are under this age in the rest of the sample. The proportion of women in the anthropometric sample aged 40 years or more is small because such women are less likely to have children in the 3-36 months age group.

The share of rural dwellers is slightly greater, and urban dwellers modestly lower in the anthropometric sample than in the rest of the population group. This phenomenon is also reflected in the distribution of women across the socio-economic zones. The more urbanized zones 1 and 2, and the non-estate central south hill areas are somewhat under-represented in the anthropometric sample while socio-economic zone 5

with a sizeable estate population, and rainfed areas of the dry zone (zone 7) are slightly over-represented compared to the rest of the population of the SLDHS sample.

Table 2.1 Per cent distribution of ever-married women by selected socio-economic group according to the women in the anthropometric sample, and rest of the women in the SLDHS sample (weighted data)

Characteristic	Per cent of ever-married women in Anthropometric sample	Rest of the sample
Number of women	1923	3942
All	100.0	100.0
Age group		
under 25	5.9	3.1
25-29	27.5	7.9
30-34	30.1	13.8
35-39	21.3	19.7
40-44	11.8	22.1
45-49	3.4	33.4
Residential type		
Urban	13.5	17.4
Rural	80.3	76.3
Estate	6.2	6.3
Years of schooling of women		
No Schooling	8.8	12.3
1-5	28.9	30.0
6-9	36.7	35.9
10 & above	25.6	21.8
Socio-economic zone		
Zone 1	7.9	10.1
Zone 2	13.9	16.2
Zone 3	14.3	13.8
Zone 4	21.5	23.2
Zone 5	21.9	18.9
Zone 6	6.8	7.0
Zone 7	13.7	10.8

Although the women in the anthropometric sample show a slightly lower proportion of less educated the two population groups do not vary significantly in their educational levels. The distributions of the women in the two samples are different mainly because of their age and recent fertility experience. The anthropometric sample population could be seen as a nationally representative sample of women who had

young children — more precisely, a cohort of children between the ages of 3 and 36 months.

2.10 Data on Age

The age of both mothers and their children is relevant here. Information on age in completed years was collected in the household schedule for all persons listed in the schedule. These data were obtained in response to the following question which came after recording the name, sex and residential type: `how old is he/she?'; space for two columns was provided in the schedule to record the age in years. The WFS experience was that this kind of approach could lead to errors in age reporting, and WFS suggested that when only the age is collected the phrase `completed years' needs to be added as it will remind the interviewer to record the age in completed years (Jemai and Singh, 1987:131).

The SLDHS interviewers were, however, asked wherever possible to obtain the date of birth and calculate the age of the individual in completed years. To enable the interviewers to estimate the age accurately and easily from the reported date of birth, an age determination table was designed for the use of the interviewers. The interviewers were particularly advised to probe for the date of birth when recording ages of females who reported ages around the extremes of the eligibility criteria, to avoid the possibility of eligible respondents being missed or others being included as eligible through misreporting of ages at and around the ages 15 and 49.

The age distribution of the females derived from the SLDHS household schedule was compared with that of the 1984 estimates and found to be virtually identical between ages 15 and 35; slight deviations were noted in the rest of the age groups 35-49 (Department of Census and Statistics, 1988: 14).

2.10.1 Respondent's age

The errors in reporting one's own date of birth can be used to demonstrate not only the quality of age data but also the quality of some other pieces of information: if a woman

cannot accurately report her age she is more likely (though not necessarily) to misreport times and durations of other events as well. In the SLDHS, any respondent who was unable to report the exact date of birth was probed for her age. Of the total women in the anthropometric sample 91 per cent were able to report the complete date of birth with the year and month of birth while a further 5.4 per cent reported both year of birth and their age. Thus it was only in about 3 per cent of the cases that the ages of respondents (mothers) had to be estimated or imputed. Although the ability to report both year and month of birth does not necessarily mean high quality age data this information is used to examine the variation in the pattern of age reporting by various socio-economic groups. This is attempted in Table 2.2.

The proportion of women reporting complete date of birth varies according to the socio-economic background of the respondent: urban women reported date of birth better than rural and estate women. Estate women, surprisingly, show a modestly higher proportion of reporting for both year and month of birth than rural women. The observed reporting pattern of the estate population may be due to the citizenship requirements: almost all Indian Tamil respondents in the anthropometric sample may have been born in Sri Lanka and by the time they were born the majority of them were considered children born to parents who were `stateless'. Therefore it is quite natural to register these births as the possession of a birth certificate is essential documentary evidence for claiming citizenship.

The proportion of women reporting both year and month of birth increases progressively with level of education: 69 per cent of women with no schooling reported both, whereas virtually all women with higher education fully reported year and month of birth. Women categorized under `other religion' tend to report date of birth more completely than the others. The differentials observed are not statistically significant.

Age reporting in each of the residential sectors if examined controlling for the level of education, it is seen that women with secondary or higher education tend to report both year and month of birth irrespective of where they live. Of women living in urban and rural areas the percentage reporting complete date of birth varies with the

Table 2.2 Per cent of mothers reporting both year and month of birth according to socio-economic characteristics (weighted data)

Socio-economic characteristic	No.of women	Per cent reporting both year and month	Per cent reporting year and age
All women	1923	90.9	5.4
Residential type			
Urban	260	97.2	1.4
Rural	1544	89.9	5.9
Estate	119	90.8	7.4
Years of schooling			
No schooling	169	68.6	12.3
1-5	556	83.4	11.0
6-9	706	96.1	2.9
10 & above	492	99.5	0.2
Religion			
Buddhists	1585	91.6	5.0
Hindu	113	85.4	8.7
Christians	103	83.5	10.3
Others	122	93.9	2.9
Years of schooling & residential type			
No schooling and:			
Urban	9	70.0	10.0
Rural	117	59.4	15.8
Estate	43	93.1	3.2
1-5 years and			
Urban	50	92.5	3.7
Rural	449	82.1	11.6
Estate	57	86.1	13.1
Above Primary and			
Urban	202	99.6	0.4
Rural	977	97.1	2.1
Estate	19	100.0	-

level of education: for urban women, it increases from 70 per cent of those without any schooling to 93 per cent among women with primary level of education and reach almost 100 per cent for those with secondary or higher education. The rural women demonstrate a similar pattern but their percentages are consistently lower than those of

urban women for each educational category. Pattern of age reporting among the estate women according to the educational level is less clear because of the citizenship formalities described above.

2.10.2 Birth history and age of child

For each respondent interviewed, the SLDHS probed for her cumulative fertility or the children she had ever borne. Those who answered affirmatively were asked about the number of sons and daughters who were currently living with them, sons and daughters who were living elsewhere, sons and daughters not living now, and the total number of children living with them and living elsewhere and total number of children dead. From the responses to these questions, the total number of children ever born and total number of children surviving (or dead) were determined.

Thereafter the survey recorded for each birth, beginning from the first birth, information such as name, sex, date of birth, survival status, age at death if not living, and age of living children. After recording the total live birth history, the interviewer counted the total number of children listed, the total number of children recorded as living and dead and compared these totals with those recorded previously. Any discrepancy was probed into and necessary corrections were made. This approach was, in fact, found to be very useful and assisted the respondent to report and the interviewer to record the complete birth history as accurately as possible.

The birth history data yielded an average number of children born to a woman as 3.0 and a total fertility rate of 2.7 for the period 1984-1987, which were in conformity with the expected rates. For the SLDHS sample as a whole, in about 5 per cent of the cases the complete date of birth of children was not given. In the case of the anthropometric sample, children were identified for measurements based on the reported date of birth; among them there were only two cases where month of birth was not stated in the schedule and which were therefore eliminated from the data file (Department of Census and Statistics, 1988:112).

As the children subject to the study belong to the more recent cohort, the age

data are expected to be of good quality since problems of recall lapses and forgetting are very much less likely to affect the reporting of events and dates. The single-month distributions of the child population (3-36 months old) examined did not show any evidence of age heaping (distributions not shown here). A similar conclusion was made by others who examined the age data of the SLDHS anthropometric sample (Rutstein and Summerfelt, 1989:4).

2.11 Proportion of Children not Measured

It is in fact not the age reporting of the children but the number of children identified for measurement and the proportion of children ultimately measured for length and weight that was a matter for concern. As shown in Table 2.3, the vast majority (92 per cent) of children identified for measurement (2203) were successfully measured for both weight and length. This proportion does not vary very much according to the urban, rural, and estate sectors.

Table 2.3 Distribution of children aged 3-36 months according to whether measured for their length and weight and reasons stated for the inability to record measurements by urban-rural-estate residence, SLDHS, 1987

Place of residence	No. of Children Identified	Measured	(%)	Not measured due to (per cent distribution) (1)	(2)	(3)	(4)	(5)	(6)
All	2203	2021	91.7	1.5	0.4	1.2	0.1	1.7	3.4
Urban	314	284	90.4	1.0	0.6	-	0.3	3.2	4.5
Rural	1611	1481	91.9	1.7	0.3	1.2	-	1.8	3.1
Estate	278	256	92.1	0.4	0.4	2.8	-	-	4.3

Note: (1) Child sick (2) parents refused (3) child not available (4) child cried (5) other reason (6) unspecified.

In the field, weight and length were measured at one or more centres in the PSU; these centres were identified in advance during updating of household schedules. The instructions were to request the mothers to bring their children to the measuring centre (normally in close proximity). The children who were not brought to the centre were

visited for measurements before the survey team left the area. Supervisors were particularly instructed to make sure not to miss such children as they are the ones more likely to have high nutritional risks.

At the other end of the scale there was a possibility of losing children (aged two to three years) who avoided being measured by running away; this was one of the problems anticipated from the experience of the pre-test. Such omissions can lead to biases mainly because most of these children could be the ones who are very healthy. The proportion of children not measured for these reasons were however negligibly small: 1.5 per cent, the same as for the child being sick. This proportion is somewhat higher in the rural sector and lower in the estate areas. The proportion of children not measured because the child cried is only 0.2 per cent: the SLDHS report shows that there were 82 children (3.7 per cent) whose weight was measured but whose length was not measured for this reason (Department of Census and Statistics, 1988:113). This may explain the relatively high proportion (5 per cent) observed in the `other' and `unspecified' categories. Among the children for whom no reason for not measuring was given, about half were either three months old or 36 months old: the exact reason for the concentration of these cases at the two extreme ages cannot be precisely explained.

There were very few not measured because of refusal by the parents, but those who were not measured as they were not present at the unit were somewhat more numerous, particularly in the estate sector. Thus there is not much evidence for a systematic bias in the data arising from not measuring nearly 9 per cent of children: but the presence of a comparatively large proportion (3.7 per cent) of children whose length is recorded but not the weight, is a matter of some concern.

Although 2021 children were measured, in the case of 18 children the reported data were not plausible considering their age. Probably this anomaly was caused at the data entry stage rather than in the field and since there was no possibility of resolving this, such cases were eliminated from the data file.

2.12 Measurement Procedures

The weight of children was measured using a portable Salter spring balance with a 25 kilogram capacity where weight can be recorded to the nearest 0.1 kilogram. The nude weight of the child was preferred but for practical reasons light dress was permitted. The recumbent length of the children was measured irrespective of their age, using light-weight wooden boards with a headpiece and a movable footpiece. Length was measured to the nearest millimetre.

2.13 Digit Preference

As in age data where preference for certain digits is often marked, there is also a possibility of digit preference in the reading and recording of the anthropometric measurements. These data biases are however free from the characteristics of the child, the mother or the household: the bias is on the part of the measurers. In order to detect possible reporting bias due to digit preference the frequencies of the reported data have been aggregated separately for weight and length according to the terminal digit for the sample as a whole and are presented in Figures 2.1 and 2.2.

If the data are equally distributed between the digits, each should have 10 per cent. If this level is the theoretically expected level then anything higher than that shows a heaping or concentration while anything lower than the theoretical level should indicate a `depression'. There is evidence of significant `depressions' of weight data at digits ending with `0', `3', `7' and `8'. As a result, there is a noticeable heaping (or concentration) at terminal digits `1', `2' and `9' (Table 2.4).

For length, the pattern of concentration and `depression' is much more evident; there is clear evidence of heaping at digits `0', `2' and `5'. These digits are conventionally considered as favoured digits in reporting age or year of birth. There are also clear and consistent `depressions' at all digits from `6' to `9'. While the examination of relative concentration and depressions at different terminal digits provides a broad assessment of the direction and the trends in the quality of reported anthropometric data, the actual bias in the reporting data can be assessed by examining

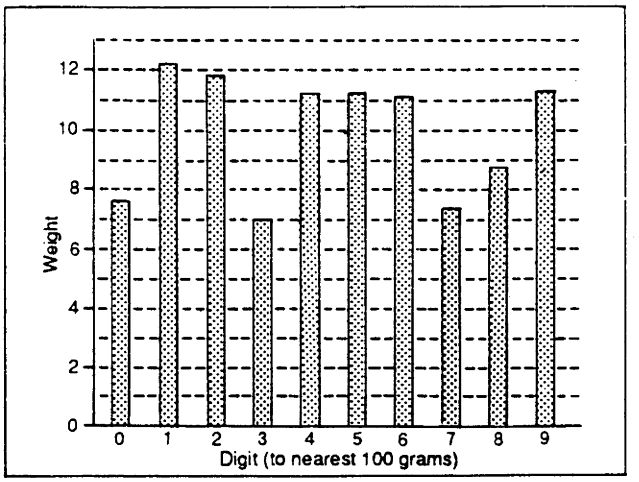

Figure 2.1. Relative concentration of reported weight measurements by terminal digit.

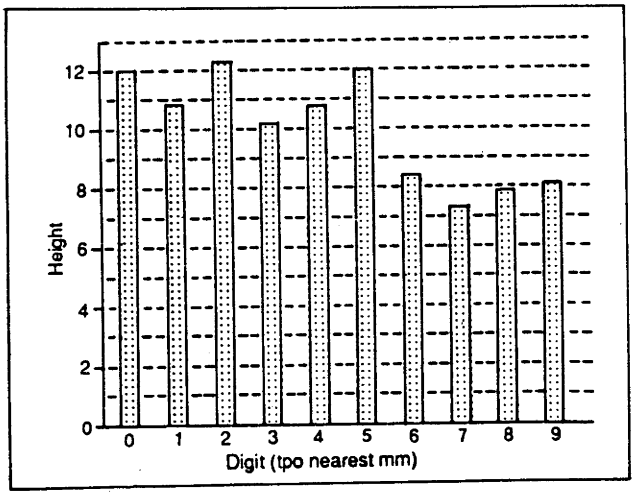

Figure 2.2. Relative concentration of reported height measurements by terminal digit.

Table 2.4 Per cent distribution of reported weight and length values by selected terminal digits according to measurer

Measurer	No. of Measure-ments	Digits ending with							
		`0'	`5'	`2'	`7'	`0'	`5'	`2'	`7'
		weight*				Length**			
1	193	8.8	11.9	8.8	11.4	12.4	10.4	8.8	11.8
2	241	8.3	7.1	13.7	6.2	13.7	7.9	8.3	5.0
3	105	3.8	9.5	11.4	5.7	7.6	10.5	10.5	5.7
4	232	6.5	9.1	14.6	4.3	14.2	10.3	9.1	7.8
5	110	12.7	18.2	11.8	3.6	11.8	9.1	10.0	9.1
6	102	8.8	13.2	9.8	6.9	22.5	7.8	7.8	6.9
7	178	7.3	11.2	10.7	9.6	7.3	11.2	13.5	5.1
8	163	6.7	6.7	14.1	6.1	8.6	12.3	11.7	5.5
9	202	9.4	11.9	14.4	5.9	17.8	14.9	9.4	6.9
10	123	8.1	16.3	10.6	10.6	7.3	10.6	15.4	9.8
11	110	9.0	9.0	16.4	7.3	11.8	24.5	13.6	5.5

* weight to the nearest 100 gm.
** length to the nearest mm.

Note: Measurers who performed 100 or more measurements only have been included in the table.

the possible digit preference of the individual measurers. This investigation revealed a tendency for a heaping at different terminal digits on the part of the measurers: virtually every measurer demonstrated this tendency. In the case of weight reporting the dominant trend has been towards avoiding digits ending with `0', `3' and `7', which was pronounced among 10 out of 11 measurers who performed 100 or more measurements each. Similarly, at digits such as `5' and those adjacent to `depressed' digits of `0', `3' and `7', there was a clear concentration.

As stated, the above pattern of length data reporting tended to show a clear heaping at three `conventional' digits: `0', `5' and `2' (Table 2.4). The apparent `depression' is found among digits ending with `7', `8' and `9' and to a lesser extent at `6' and was observed among the majority of the measurers. The results of the frequency distribution of the reported weight and length values for each of the measurers are not

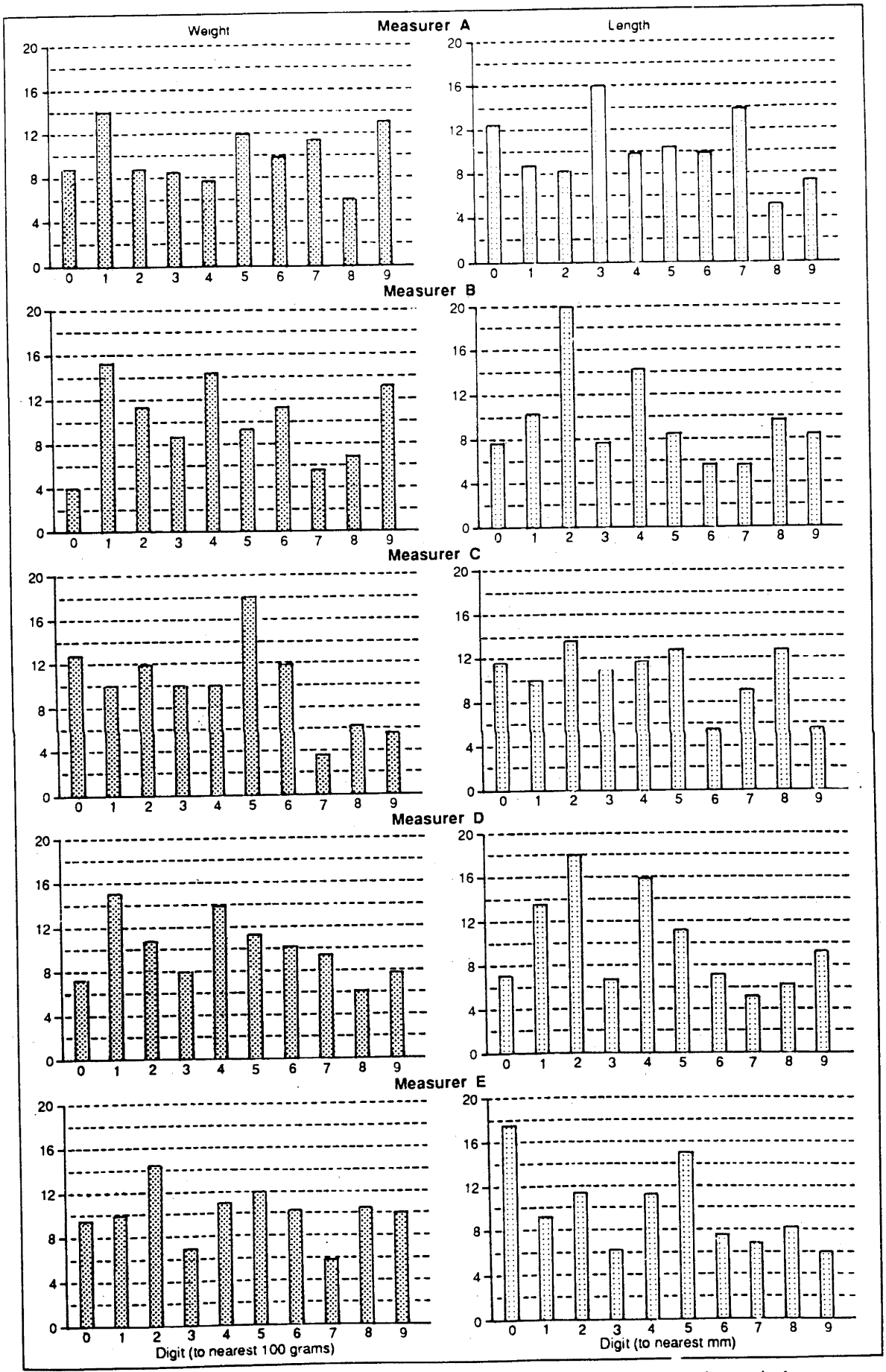

Figure 2.3. Relative concentration of reported weight and height measurements by terminal digit and person reporting measurements (selected measurers only).

shown here but are illustrated for a sample in Figure 2.3. These provide a picture of the status of reporting at favoured digits or depressions at digits which are less favoured (or adjacent to the concentrated digits).

It is of interest to examine whether the observed pattern of heaping is common to every segment of the child population or whether it is confined to children of certain age groups. To assess this the reported frequency distributions for weight and length at different digits have been aggregated according to three broad age groups of children, and are shown in Table 2.5.

Table 2.5 Per cent distribution of reported weight and length values according to terminal digits and age group of child

Terminal digit	Age group in months					
	Weight*			Length**		
	3-11	12-23	24-36	3-11	12-23	24-36
0	8.1	7.7	7.3	13.5	10.4	12.6
1	9.8	13.6	12.9	12.4	10.9	9.5
2	14.9	8.9	12.7	12.4	12.3	12.2
3	6.2	7.3	7.3	10.2	11.2	9.2
4	10.7	12.1	10.5	9.3	10.3	13.0
5	11.7	9.4	12.7	13.0	13.5	9.5
6	11.4	11.2	10.8	6.9	9.3	8.8
7	9.2	7.2	6.1	7.6	6.7	7.6
8	9.0	9.2	8.3	6.9	8.0	8.3
9	9.0	13.4	11.3	7.8	7.4	9.2

* weight to the nearest 100 gm ** length to the nearest mm

There is evidence of a somewhat noticeable `depression' of values reported for weight at digits `0' and `3' irrespective of the age group of the child. For children above 11 months of age, there is a `depression' at digit `7' while a similar condition is seen at digit `8' for those between 24 and 36 months old. For children aged 3-12 months, weight data are affected by heaping at digits `0' and `5' and to a lesser extent at `1' and `2'. For children 12-23 months old, heaping is somewhat substantial at digits `5' and `2'

while for children 24-36 months, concentration of length values can be seen at `0', `2' and `4'. For digits ending with `6' to `9' there appears to be a slight `depression' at virtually every age group.

Although the direction and the extent of reporting biases were different between the measurers the overall distributions, particularly for the weight data reporting, minimized the effect of data bias. In their comparative study of DHS anthropometric data relating to Sri Lanka, Senegal and Brazil, Rutstein and Summerfelt (1989:4) did not find substantial heaping in the weight data for the sample as a whole. Despite somewhat greater concentrations and depressions at terminal digits at the level of the measurer, the overall data for reported length values are not as unsatisfactory as one would expect. The results of the standardization test confirm this view.

As previously mentioned, at the end of the training session a standardization test was conducted. A similar test was carried out midway through fieldwork. The data on the latter test for each of the measurers are not available for detailed analysis but a preliminary analysis carried out by IRD showed that length measurements were slightly (average 1.9 mm) overestimated by about 55 per cent of the measurers in comparison with the trainer's measurements; about 29 per cent underestimated by about 2.7 mm and the remaining 16 per cent were in agreement with the trainer. Overall in about 91 per cent of the cases the length measurements were within half a centimetre of that of the trainer (Department of Census and Statistics, 1988:11). These measurement variations fall well within the tolerance limit of 0.5 cm suggested for the evaluation of anthropometric data collected in household surveys (United Nations, 1986:92). As expected the quality of weight measurement was better; it was found to be accurate within 100 grams. Despite the evidence of a bias due to the possible digit preference discussed earlier, the SLDHS data on weight and length can be considered reasonably good quality for the assessment of nutritional level according to subgroups of the population.

Summary

This chapter described the main activities of the Sri Lanka Demographic and Health Survey (SLDHS) of 1987 with special emphasis on the sampling design and demarcation of socio-economic zones. The SLDHS data were collected from a well designed representative sample of Sri Lanka except for the eastern and northern provinces where survey work was not possible because of the political disturbances. The elimination of these two provinces with about 15 per cent of the population in the country has a disadvantage as there is under-representation of two main ethnic and religious groups: Sri Lankan Tamils (majority Hindus) and Sri Lankan Moors (Moslems).

A broad evaluation of data was also carried out using the age data relating to the mothers and children and it was found that they are of reasonably good quality. The reported weight and length data, however, showed some irregularities suggesting the effects of possible digit preference on the part of the measurers. Although the extent of this bias was somewhat pronounced among the data reported by individual measurers, the overall distributions were not much affected by the digit preference. However, the data on length measurements were unsatisfactory for the very young infants.

Chapter 3

Method of Analysis: Choice of Indicators of Nutrition, Identification of Children at Risk, Framework of Analysis Measurements and Methodology

3.1 Introduction

Status of growth, as measured by anthropometric means, is considered to be the most important indicator available on the nutritional experience of children and is increasingly being used to evaluate health conditions of children, particularly those under the age of five years (McLaren and Read, 1972). It is preferred to clinical evaluation of nutritional status `because of the scarcity of clinical signs suggestive of nutritional deficiency, their lack of specificity, and the notoriously limited extent to which results can be reproduced by different examiners' (Scrimshaw *et al.*, 1967:10). The growth and development of children are considered to be sensitive indicators of protein-energy malnutrition and have formed the basis for growth charts (Morley, 1977a; Morley and Woodland, 1979).

Using anthropometric data on weight and height of the children, three nutritional indicators can be constructed: one is the weight for height (length); the other two are constructed relating the weight and height to the age of the child; weight for age, and height (length) for age (WHO, 1983). In the assessment of nutritional status, there are several issues that have to be considered; among them, what indicators best represent the nutritional status relating to the study population and measurements? What reference population will be used to compare the observed anthropometric values of individual children? What is the best statistical measure to express the nutritional status of children in comparison with the reference population? What is the suitable cut-off point for the identification of children who are at-risk?

The present chapter briefly addresses each of these issues, which are relevant to the current research. This chapter also gives an outline of the framework of analysis on

which the present research study is largely based and illustrates the main statistical methodology that is employed in the assessment of influence of socio-economic and behavioural influences on child undernutrition.

3.2 Choice of indicators of nutrition

Perhaps the best known and widely used indicator of nutrition is weight for age. This indicator was used in the early 1940s by Gomez and others in the identification of the malnourished for treatment: they compared the weight of children on admission to hospital with the weight of a normal child of the same age to assess whether or not a child was deficient in weight. Thereafter, for the purpose of treatment, they graded the level of nutrition of the children into three groups: if the observed weight was between 75 and 89 per cent of the reference values, the child was considered to be suffering from first degree malnutrition; if between 60 and 74 per cent second degree malnutrition, and if less than 60 per cent third degree malnutrition (Gomez *et al.*, 1956:77). Later many workers have preferred to use 80 per cent and 60 per cent as cut-off points.

This system of assessment and grading, popularly known as the `Gomez classification', has been used in many countries for the identification of malnourished children and has formed the basis for charting growth in nutritional surveillance programmes (WHO, 1963, 1978; Morley and Woodland, 1979; Wray and Aguirre 1969:78). This indicator shows the extent of underweight of a child compared to median weight of a child of that age in the reference population.

Height (or length) for age, measures the linear or the skeletal growth. The height (or length) of a child does not vary quickly in response to short-term health and economic changes. Height can increase but can not decrease. Since changes in length take place comparatively slowly; as a result, short-term changes in the growth pattern cannot be detected from this measure. Hence, theoretically this may not be the best indicator for predicting the risk of subsequent morbidity and mortality, unless severe long-term effects will include severe reductions in both weight and height of a child

(Behar, 1981:242). It is an indicator of past (and also continuing) or long-term problems in food intake and health.

In many populations secular trends in growth have been accompanied by the increases in stature; therefore, this indicator is very important in assessing the secular trends in nutritional levels (Johnston and Lampl, 1984:58). Low height (or length) for age is normally caused by inadequate food intake with or without the added influence of infections (Waterlow, 1978:457). Height for age is also considered as a good indicator of social deprivation and thus its high prevalence signifies the presence of a serious social and economic problem (Waterlow, 1984:86). Compared with weight, accurate measurement of height (length) requires greater measuring skills and experience.

The weight for height (length) indicator, by contrast, measures body size according to attained height (length). The measurement of tissue mass can change quickly according to the most recent food intake and health condition of the child. Consequently, weight for height (length) is a very useful indicator of recent malnutrition. Deficits in weight for height (length) can develop and disappear very quickly. As such it is a good indicator to assess the very short-term changes in nutritional status.

However, it is not an efficient indicator to use for assessing long-term changes in nutritional status (Waterlow, 1984:84). Weight for height (length) as a measure of nutritional assessment is free from the errors arising out of deficient age reporting to which the other two measures are often subject. To construct this index, values for both weight and height (length) are needed. The main disadvantage of this indicator is that it is often difficult to measure the body length of very young children accurately. As it is a nutritional indicator which expresses weight in relation to height (length), it does not give any information on the duration (or past level) of nutrition (Keller, Donoso and DeMaeyer, 1976:599).

Among the three anthropometric measurements, weight for age has the advantage that it is relatively easy to measure with a minimum degree of training and with reasonable accuracy. Studies conducted elsewhere have found that this measure

can be used as a predictor of under five mortality (Chen, Chowdhury and Huffman, 1980; Kielmann and McCord, 1978). One of the drawbacks of the measure of weight for age is its inability to detect cases with severe malnutrition (specifically, cases of kwashiorkor with oedema). When these conditions are present, the weight of the child increases because of fluid retention can potentially push the weight for age of an undernourished child above the cut-off point of 60 per cent of the median reference weight for age (Keller, 1983:132). Weight for age being a reflection of both linear and soft tissue is a composite indicator of long-term and short-term malnutrition. The former condition — long-term undernutrition — is also known as `stunting' and short-term undernutrition as `wasting' (Waterlow, 1972). Weight for age values do not permit the distinction between children who are stunted and fat and children who are tall and wasted. In other words, it does not indicate whether the observed low weight for age is due to a recent food (or health) problem or to a long-term undernutrition problem. This distinction is particularly important in the classification and treatment of an individual child (Seoane and Latham, 1971; Waterlow, 1972). These deficiencies and the drawbacks of weight for age as a measure of nutrition, were discussed at length by the 1971 joint Food and Agricultural Organization/World Health Organization expert committee on nutrition (WHO, 1971). The Wellcome Trust Group attempted to rectify some of these drawbacks by proposing a classification which permits the identification of nutritional conditions such as marasmus, kwashiorkor, and nutritional dwarfism (Wellcome Group, 1970:302-303). Such classification was also found to be less effective and has failed to consider several deficiency conditions (McLaren, 1971) and is useful in hospital and clinical studies than in field surveys.

In the middle of the 1970s alternative anthropometric indicators such as the mid-arm circumference, weight for height and height for-age were introduced and recognized for nutritional assessments (Waterlow, 1972). In 1976 the joint FAO/UNICEF/WHO expert committee on nutrition, recommended the inclusion of weight for height and height for age in the nutritional assessment of infant and pre-school children and suggested these as the primary indicators of nutrition for school-age children (WHO,

1976). After considering the problems associated with the indicator of weight for age, and in accordance with the recommendations by the Joint Expert Committee of 1976, Waterlow *et al.* (1977) put forward guidelines for the use and interpretation of the data relating to weight and height for the assessment of nutritional status of children 1-10 years; for this age group they endorsed the use of both weight for height and height for age as primary indicators of child nutrition. They recognized that weight for age is a valid index when the height data are highly unreliable (Waterlow *et al.*, 1977:491).

In most developing countries there are large proportions of children of pre-school age who do not have adequate weight for their age, but do not have noticeable impairments in health. The majority of these children can be considered normal when their weight in relation to attained height is considered. They are short because of inadequate growth in the past and are not undernourished at present. If weight for age is used as the indicator of malnutrition then these children will be classified as undernourished, which is far from the actual situation (Behar, 1981:241). In a society where long-term undernutrition is common, weight for age will not be a good indicator of recent undernutrition and overstates the prevalence of undernutrition (Anderson, 1979:2341).

Keller examined the correlation between the values of the three anthropometric indicators discussed above, and showed that among them weight for height and height for age are virtually independent of each other as they measure two completely different aspects of nutrition (Keller, 1983). He then examined the effects of values of weight for height and height for age on weight for age in terms of standard deviation units and found that 95 to 98 per cent of the variation in weight for age was due to variation in weight for height. Keller attributed the remainder of the variation to measurement error (Keller, 1983). On the basis of these observations, Keller and Filmore concluded that `weight for age **duplicates** but **does not add to** the information obtained from more specific indicators, height for age and weight for height' (Keller and Filmore, 1983:133; emphasis added). They added that using height for age and weight for height in the assessment of malnutrition in field surveys will give a clearer picture of the type of malnutrition and also allow the determination of priorities for intervention.

A World Health Organization Working Group which reviewed `the purpose, use and the interpretation of anthropometric indicators of nutritional status' also favoured using weight for height as the indicator of current malnutrition. They recognized weight for age as an indicator of nutrition which can be used to obtain an overview of a nutritional situation or its changes in a country, but stated that the indicator of weight for height alone is sufficient for counting the malnourished (WHO, 1986:936).

Despite its limitations, weight for age is still considered a useful indicator for several reasons: this indicator is basically preferred by the program personnel because it is easy and simple to record provided that the weighing scales are good (Hansen, 1984:96); it has also been found that weight for age correlates well with socio-economic indicators (Hansen, 1984), and thus it is considered one of the most useful development indicators (Dowler *et al.*, 1982); the other reason that this indicator is increasingly being used is that, since it overstates the actual prevalence, it helps to emphasize the seriousness of the problem so that policy makers will act quickly (Waterlow, 1984:86).

Although the basic data for certain socio-economic groups are shown according to the weight for age indicator, the focus of this research is on length for age, to study long-term undernutrition, and weight for length for the study of more recent under-nutrition.

3.3 Choice of a Reference Population

Choosing a reference population for the comparison of nutritional status of children has also been a subject of debate. Among growth `reference standards' available, those of Boston or Harvard, the National Centre for Health Statistics (NCHS), and NCHS-WHO (World Health Organization) are widely used in developing countries. The Gomez Classification used the Harvard standard which was based on anthropometric data from a group of middle-class Caucasian children living in the US during 1930-1939. The data were collected from about 400 children at regular intervals from birth to 13 years. In 1974 the NCHS compiled a growth reference for US children taking two sets of data gathered from a contemporary US child population with different socio-economic and

ethnic backgrounds (Hamill *et al.*, 1979). One set relates to children from birth to three years collected by the Fels Research Institute. The other was from the Health Examination Survey (HES) of 1963-1970 and Health and Nutrition Survey (HANES) of 1971-1974. This reference has been widely used in many countries irrespective of their different living standards, ethnic or racial and geographic distributions. The World Health Organization has also used the NCHS data base and prepared a new set of reference tables, including the centile values for growth monitoring purposes (WHO, 1978).

A comparison of Harvard, NCHS and WHO standards by Stephenson and colleagues (1983) showed very close similarities at 50th percentiles. The Harvard standard contains height (or length) values of children measured according to recumbent length while the other two standards used recumbent length up to 24 months and standing height thereafter. Despite these changes in the procedures of measuring, Stephenson *et al.* (1983:16) found no major differences between the three growth standards especially for young children.

The use of a reference standard from a developed country to assess the nutritional status of children in developing countries has raised doubts. The main concern in using an international standard is whether or not child growth is influenced by genetic factors. According to some, there are observable genetic differences in growth (Graham *et al.*, 1979; Seth, Sundaram and Gupta, 1979). For instance, Graham and others found, when the Boston standard was used, substantial racial differentials in age-specific growth rates among poor urban pre-school children in Peru (Graham *et al.*, 1979:705).

Habicht and others examined the question of ethnic or racial differentials using evidence from studies, representing varied racial, geographic and socio-economic backgrounds, including data from Bogota, Colombia and Black children in the US; they concluded that differences in height and weight are very small between the ethnic groups; 3 per cent and 6 per cent respectively. By contrast they found that the growth

differentials are greater (12 per cent for height and 30 per cent for weight) among pre-school children of similar ethnic and geographic backgrounds according to the social class or economic background.

Therefore, they concluded that the differences in growth between any elite ethnic groups are so small that `height and weight data from any well-to-do children can be used as standard to compare the mean growth curves of pre-school children' (Habicht *et al.*, 1974:614). In attempting to resolve the problem of a reference population Graitcer and Gentry (1981) examined the studies carried out covering children from privileged classes in Egypt, Togo, and Haiti and compared them with the NCHS-CDC (Center for Disease Control) growth standard. They found that the growth patterns of privileged children in the three countries were very similar to those of children in the reference population. They also observed that at certain heights and ages, privileged children were slightly heavier than the reference children.

Accordingly they stated that there is no difficulty in using `one reference' for all countries in the assessment of growth patterns of children. Similar results have been found in other studies as well (Bohdal, 1969; Blanco *et al.*, 1974; Amirhakimi, 1974; Morley and Woodland, 1979; Mora, 1984:104; Martorell, 1985:24-25; Briones *et al.*, 1989). Therefore it is suggested that the differences in growth pattern between social groups are mainly a reflection of health and environmental factors rather than genetic factors. Similar evidence is available from Sri Lanka as well: the Sri Lanka Nutritional Survey of 1975/76 found that for both height-for-age and weight-for-age, although the values are below the reference for each age, the median values of growth of the upper socio-economic class pre-school children of Colombo, had a growth pattern very close to the reference population (USDEH, 1976:44).

In 1971 the International Union for the Nutritional Sciences (IUNS) proposed the that creation of growth standards for national populations based on the weight and height data from elite groups or children living in `optimal' settings (IUNS, 1972). Goldstein and Tanner (1980:584) claimed that such an attempt is fruitless as any

reference population derived from the data collected from developed countries is inappropriate for use in developing countries; they suggested that national growth standards derived from data on elite or high socio-economic groups are equally inappropriate. Their view was that even for in-country comparisons, one growth standard would not serve the purpose and there should be several standards for different socio-economic groups.

In view of the growth differentials between reference populations in the developing world, particularly in Asia, Eusebio and Nube (1981:1223) considered that the `conclusion that ethnic differentials are negligible' was unwarranted, particularly for the Asian populations. They considered the growth values observed among the better-off children in developing countries as a reflection of what they called `attainable growth', and suggested that when there were wide differences between population groups, to use local growth standards or Western standards could be used with suitable adjustments to the cut-off points for the identification of the malnourished.

It remains unresolved however, whether height (or length) is as relatively free from the influence of ethnic differentials as weight. It is generally believed that growth patterns of children under the age of five, unlike those at and after the age of puberty, are not very much influenced by their genetic backgrounds (Waterlow, 1980b:717). Martorell, Mendoza and Castillo (1988) who examined differentials in stature among different child population groups of the world found that children of Asian origin, mainly Japanese and Chinese, were shorter than the NCHS children. The difference in stature among children at ages 5-7 months that can be attributed to genetic influences is estimated to be about 3.5 cm. Martorell and others also showed that among the population groups of similar ethnic origin the differentials were much greater: about 12 cm. A large part of the difference was therefore due to socio-economic and environmental causes (Martorell *et al.*, 1988:64).

An important difference between the growth standards of developed countries arises from differences in the pattern of breastfeeding; longer breastfeeding durations in

developing countries compared with the reference population give rise to faster growth potential in the full breastfeeding period of the first six months or so. To overcome this, some researchers have proposed separate references for the first six months and for other periods (Whitehead and Paul, 1981, 1984); this adjustment seems unnecessary.

In addition, a few developing countries such as Colombia, Brazil and India have attempted to provide their own reference standards for growth monitoring. It is not feasible for each country to have its own reference standards as, *inter alia,* it is not always possible to have a representative sample of well-fed population and to find a sufficient number of babies (at least 200 at each age) to prepare reliable growth standards according to the suggested criterion (IUNS, 1972; Waterlow *et al.*, 1977; WHO, 1978). This is even more difficult in a country where poverty is a serious problem as Martorell (1985) points out: the prevailing low stature among children of different socio-economic groups is mainly a reflection of poverty and health problems and these conditions are uniformly common to every ethnic group. Therefore, it may be difficult to find a suitable number of well-off children from these societies for the preparation of growth standards (Martorell, 1985:25). In the circumstances it is not unrealistic to use reference values based on well-fed children in developed countries for evaluation of growth patterns of children in developing countries (Jelliffe, 1966; Haaga *et al.*, 1985).

Also, when the general nutritional level of a population is rising, having local reference standards are fruitless and poses difficulties, particularly having several sets of standards for different periods and for different social groups: such efforts will lead to confusion (Hansen, 1984:92). Hence it is convenient and useful to use a reference standard from a developed country whose nutritional levels are `no longer subject to rise'. This is a good reason to use an international growth standard for comparison (Morley, 1977a: 397).

Even though there are growth differentials between the populations, due largely to the cumulative effects of adverse environmental conditions, the growth standards

derived from Western countries can be used as long-term goals to be reached by future generations (Mora, 1984:102). It has been suggested that international standards should be treated as reference populations and not as norms or targets (Waterlow *et al.,*, 1977; Neumann, 1979). Waterlow and others reviewed the growth reference standards available in 1977 and found that none of the available growth standards met the minimum criteria (listed above) of an ideal growth reference. They noted however, that among the growth standards they reveiwed, the NCHS standard met most of the criteria and they therefore suggested its use as an international reference standard (Waterlow *et al.*, 1977:490).

This reference has since been used in most nutritional surveillance programs in the world. Later, the World Health Organization recommended the use of the published NCHS-WHO growth standard for international use for growth monitoring purposes, as it had details of the centile values (WHO, 1978). This reference standard is considered suitable because of the `detail, extensiveness and potential universality' (Gueri, Gurney and Justsum, 1980:775). Recognizing the suitability of the NCHS-WHO standard, the DHS global program used these values in comparing the weight and height (length) collected at national DHS surveys. Accordingly the SLDHS recoded data tapes, on which the data set for the present study is based, containing the indices of centiles, medians and standard deviation units for the observed weight and length values of each child derived in comparison with the NCHS-WHO growth reference values.

3.4 Identification of Population at Risk

Once the indicators of nutrition and the reference standards are chosen, the next task is to identify, as accurately as possible, the children who are at nutritional risk. Two steps are involved here; the first is to choose a suitable statistical measure to express the comparative anthropometric values and the second is to find a suitable cut-off. There are three measures that can be used to express weight or height in relation to a reference population; as centiles of the reference population, as percentage of median, and as the number of standard deviation units. Among these, centiles are considered less suitable

for developing countries as a substantial number of children can fall outside the percentile values of the reference standards, thus comparison is not possible (Waterlow *et al.*, 1977; Graitcer *et al.*, 1981). The main reason for this is that in the original NCHS reference standard the percentile values for children were truncated at 90 centimetres (Dibley, Staehling and Neiburg, 1987).

Percentage-of-median values on the other hand are also considered inappropriate, as these values are not constant over the ages and thus do not relate to the overall distribution of the reference population (Waterlow *et al.*, 1977; Graitcer *et al.*, 1981; Dibley *et al.*, 1987:737). For the purpose of nutritional assessment, it was recommended that the standard deviation units (z-scores) are most suitable (Waterlow *et al.*, 1977). This was later endorsed by the World Health Organization and by others in the field of nutrition who agreed that Standard Deviation Scores are most suitable for expressing the nutritional levels of children, particularly in developed countries (WHO, 1986; Keller and Filmore, 1983; Mora, 1989; Graitcer *et al.*, 1981:292). To enable the use of Standard Deviation Scores, the NHCS growth data had to be normalized; this was done at the CDC. Throughout this study the Standard Deviation Scores (z-scores) are used to express the nutritional status of the study population.

Next, a suitable cut-off point has to be decided. In most circumstances a cut-off point for the diagnosis of malnutrition is arbitrary and also subject to controversies. If a cut-off point is fixed at a high level such as one standard division below the reference median, then it will produce high levels of undernutrition by including false positives (Mora, 1989:134); this condition is described as `specificity'. If the cut-off point is fixed at a low level, say -3.00 Standard Deviations or below the reference mean, then it will fail to capture the children who are actually malnourished: this condition is known as `sensitivity'. `Sensitivity', which is the ability to accurately identify positive cases, will increase the prevalence by including `false negatives' (Himes, 1987); thus any suitable cut-off point should as far as possible be free from these two extreme biases of `specificity' and `sensitivity'.

The Gomez classification used 90 per cent of mean value of the weight for age as the cut-off point for the identification of the vulnerable (Gomez *et al.*, 1956) and this was used in many nutritional assessment programs. This cut-off point, which is approximately one standard deviation below the reference mean, was found to produce higher estimates of undernutrition or to be subject to the `sensitivity' bias (for example Mora, 1984:105), and therefore was considered inappropriate (Sykes, 1977; Gueri, Gurney and Justsum, 1980:774).

There is now increasing use of two standard deviation units below the NCHS median as the cut-off in the diagnosis of the malnourished: under this cut-off, those falling between plus and minus 2 standard deviation units of the reference median are considered normal; those below minus 2.00 are undernourished and those above plus 2.00 are overnourished (obese) (Waterlow *et al.*, 1977; Waterlow, 1985a; WHO, 1978; Keller *et al.*, 1983:133). It has been found that a cut-off point of -2.00 standard deviations correlated well with mortality and morbidity (Graitcer *et al.*, 1981). Hansen using his own studies and those of others demonstrated that a cut-off point at the third percentile or less than 80 per cent of the median expected weight of the Harvard standard was associated with high morbidity and mortality of children under the age of six years; but he did not find a clear relationship among children between the ages of 6 and 18 years (Hansen, 1984:93).

Mora (1984) reviewed the findings of studies in different countries such as northern India, New Guinea and Bangladesh, which examined the relationship between the nutritional status of children at a cut-off comparable with -2.00 standard deviation units (at which the child is considered malnourished), and the survival chances of the child. He stated that there was good correlation with the functional outcomes such as mortality, `even though mortality might not be the most adequate functional parameter for validating anthropometric cut-off points' (Mora, 1984:104). Although this criterion is used in different populations there is still no unanimity over its use; for instance the World Health Organization in its suggestions for the measuring of nutritional change suggested the use of any standard score value as the cut-off point depending on the

situation in the country, while Waterlow recently stated that for the estimation of prevalence and for nutritional surveillance any index could be used depending on the available resources (Waterlow, 1984:82).

This study uses -2.00 standard deviation units or below, as the point which separates the undernourished from the well nourished (or normal). Children less than or equal to standard scores -2.00 (or z-scores) are considered undernourished. As obesity is not a nutritional problem among Sri Lankan children, consideration of children above 2.00 standard deviation units is irrelevant.

3.5 The Framework of Analysis

A few years ago a convenient framework for the study of child survival and nutrition for developing countries was put forward by Mosley and Chen (1984). They pointed out an existing gap between social science research and epidemiological research in the study of child survival, each approach focusing only on its own area of interest. For instance, medical scientists often tend to ignore socio-economic variables and focus on biomedical aspects while the social scientists tend to focus on socio-economic aspects and ignore biomedical determinants of child survival. The virtual absence of integration between the two approaches has been largely responsible for the apparent failure in understanding the determinants of socio-economic variations in child survival. The Mosley and Chen framework is an attempt to fill the gap by integrating the approaches used by medical scientists and social scientists in the understanding of the mechanisms of child survival.

One of the important approaches in the Mosley-Chen framework is its treatment of nutrition; the framework considered nutrition as an intervening variable affecting the health of the child rather than simply a causal factor of mortality as it has been conventionally treated. The framework proposed by Mosley and Chen identifies two classes of variables affecting child survival; socio-economic and intermediate or proximate variables. The proximate determinants are grouped into five categories: maternal fertility factors, whose effects are determined by a host of behavioural factors;

environmental exposure factors which reflect mainly the hygienic characteristics of the population; nutrition, which is determined by patterns of breastfeeding, food supplementation and weaning, and availability and intake of food; injury, a reflection of patterns of child care; and personal illness control, included to represent attitudes towards and practices relating to diseases and treatment (Mosley, 1985).

These five groups of variables are treated in the framework as largely biological and are the determinants of child survival. The variations in the levels of mortality are explained by the socio-economic and behavioural characteristics of the population. The socio-economic variables do not directly affect the outcome variable but `all social and economic determinants must operate through these [proximate] variables to affect child survival' (Mosley and Chen, 1984:27).

The framework also proposes a single index of health and mortality by combining the mortality and status of nutrition in a cohort of children. This method is a departure from the conventional thinking of malnutrition as a causative factor in child mortality, and suggestive of investigation of deaths and status of nutrition in a single scale; this will ultimately form three categories of outcome variables: (a) dead, (b) living but undernourished, and (c) living better nourished (W.H. Mosley, 1988, personal communication). This approach, according to Mosley and Chen, will help to `strengthen the explanatory power of social research' (Mosley and Chen, 1984:30).

Van Norren and Van Vienen (1986) point out some of the shortcomings of the Mosley-Chen model in the study of `malnutrition-infection syndrome in developing countries'; for instance, they state that some of the proximate determinants are also behavioural. They claim to have amended the Mosley-Chen framework to permit the analysis of data at the individual, household and community level.

However, the Mosley-Chen framework provides a very convenient and useful practical approach for the study of child mortality and nutrition. The SLDHS does not provide sufficient data under each of the proximate determinants to be used in the analysis, and there is no intention in this research to test the framework in the Sri Lanka

context.

For the purpose of the present study this framework is a useful guidance; and the data available from the SLDHS have been studied and the important variables have been identified for the analysis and categorized under the following four groups.

(a) Socio-economic variables: socio-economic zone, place of current residence, years of schooling of mother and father, and occupation of mother.

(b) Demographic variables: maternal age, birth order, interval between live births, age of child, number of living siblings, sex of child and number of sibling deaths.

(c) Environmental characteristics: availability and type of toilet, type of housing, source of drinking water and any prevalence of diarrhoea among very young children.

(d) Health and nutrition characteristics: the use or non-use of contraceptives, duration of breastfeeding, food supplementation, person assisting delivery, place of confinement, childhood immunization and use of antenatal services.

The different statistical techniques used in the research are discussed in the relevant chapters in the text but the following section describes the main statistical methodology used in the analysis for the identification of the socio-economic and behavioural factors influencing child undernutrition.

3.6 The Method of Analysis

The analysis of data in the research study is approached in two ways; first the bivariate relationship of the dependent variable with the predictor variables listed above under each of the proximate variable groups is examined. For this purpose two indices are used: percentage of children who are undernourished determined from those having standard deviation scores of -2.00 or below; and mean standard deviation scores (z-scores). These relationships at the bivariate level are, however, not the main focus of the research, which attempts to assess the influence that socio-economic and

behavioural influences have on the dependent variable. These relationships are, as the Mosley-Chen framework shows, by no means simple. Various proximate determinants can have effects in different directions; some characteristics can affect the given indicator of nutritional status to fall below the cut-off while others can push the indicator above the cut-off. Therefore a suitable multivariate approach has to be employed.

In accordance with the objectives of the research, the dependent variable — the indicator of nutritional status expressed in terms of z-scores — has been treated as dichotomous (undernourished, 1 and better-nourished, 0), and therefore a logistic regression procedure is appropriate for the purpose. The logistics regression procedure is increasingly being used for such data, particularly in the epidemiological field where outcome variable is binary (Klenbaum, Kupper and Muller, 1978). The regression model fitted to the data is as follows:

$$\text{Log } (p/1\text{-}p) = B + B_1X_1 + B_2X_2 + \ldots + B_nX_n$$

where p is the probability of a child between the ages of 3 and 36 months being well nourished.

$B_1 \ldots B_n$ = regression coefficients

$X_1 \ldots X_n$ = independent (or predictor) variables.

The model illustrated above assumes that the relationship between the predictor variables and the dependent variable is additive. In certain circumstances this assumption may be correct but some of the independent variables also affect the dependent variable interactively as well. When such interactions are taken into account the model can be expressed as follows:

$$\text{Log}(p/1\text{-}p) = B + B_1X_1 + B_2X_2 + B_3X_3X + B_4X_4 + \ldots + B_nnX_n$$

$$+ X_1 (B_{11}X_1 + B_{12}X_2 + \ldots + B_{1n}X_n) + \ldots B_{nn}X_n^2$$

where B_{ij}'s are coefficients of the interactions between X_iX_j.

The logistic regression model is estimated using a statistical software package,

Generalized Linear Interactive Modelling (GLIM) developed by the Royal Statistical Society of London (Aitken *et al*, 1989). The GLIM program calculates, for each model, the overall goodness of fit, regression parameters of the independent variables, and their standard errors. The goodness of fit statistics are known as the deviance (maximum likelihood estimates) and degrees of freedom. The model selection was done using a forward entry method by estimating the χ^2 values by comparing the values of deviance and residual degrees of freedom in successive hierarchical models. The variables for the model were selected on the basis of their levels of statistical significance.

While the overall deviance is a sort of goodness of fit of a variable, the `t' statistic shows the statistical significance of each of the categories within a variable. They are obtained by dividing the deviance values by respective standard errors, and if the resulting value exceeds plus or minus 1.98, the variables are statistically significant at $p < 0.05$ level.

For a given variable the estimates provided by the logistic regression are with respect to one category of the variable; usually the first category. This is called the reference category. In the tables of regression parameters odds ratios shown refer to the exponential of the parameter estimates. The odds ratios show the relative level of risk for each category of a variable compared to the reference category. The risk in the present case is the chances of a child 3 months to 36 months of age being better nourished. The odds ratio for the reference group is by definition equal to 1.0. The odds ratio of 1.0 for any other category indicates a relative risk equal to that of the reference category; an odds ratio of less than 1.0 shows a relatively low level of nutrition, an odds ratio of more than 1.0 relatively good chances of being better nourished than the reference category.

As described in chapter 2 although the PPS was used for the selection of the SLDHS sample. Certain socio-economic zones, zone 5 with a large concentration of estate population and zone 7 where rainfed farming is prevalent, were oversampled. It should be remembered that the summary statistics estimated (such as the mean, frequencies and even life table values) for the whole sample and its subgroups have

been duly weighted by an appropriate weighting factor which are given in the SLDHS report (Department of Census and Statistics, 1988:10) In the statistical models fitted in Chapters 6 and 7, however, unweighted data were used.[1]

While the main model analyses the relationships between the dependent variable and the set of predictor variables, other approaches are also used in the research in analysing data; they are discussed in the relevant chapters. Chapter 3 having discussed the indicators of nutrition, diagnostic indicators of nutrition and cut-off points, and the statistical methodologies adopted in the research, Chapter 4 briefly explores and describes the socio-economic and behavioural characteristics of the study population.

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1 There is a great deal of controversy over the weighting of data from complex data files. According to Skinner, Holt and Smith (1989) who have discussed this issue, `if the differences between the inclusion probabilities are a function only of known design variables, such as stratum identifiers or size measures [residential areas within each zone in the present case], and if these design variables are included as independent variables in the model and the model is correctly specified then unweighted model based inference is appropriate' (Skinner *et al.*, 1989:286).

Chapter 4

Socio-economic and Behavioural Profile of the Study Population

4.1 Introduction

Having discussed the objectives, data sources and quality, nutritional indicators and statistical methodology adopted in the research, the present chapter turns to the task of examining very briefly the socio-economic and behavioural characteristics of the population. The characteristics discussed are those of the child, mother, father and the household, which relate to the research and interpretation of the results. Where relevant, these characteristics are described according to the place of current residence: urban, rural and estate areas and socio-economic zones.

The socio-economic and behavioural profile of the population is studied under six broad headings:

(a) marriage and the family;

(b) education of both parents;

(c) employment and occupation;

(d) housing and environment: basic characteristics of the housing such as the materials of construction of the walls, roof and the floor are discussed, the main source of drinking water, type of toilets and whether the household has reported a child recently having diarrhoea; and

(e) health care behaviour: use of ante-natal care services, care during delivery and immunization of children.

4.2 Marriage and Family

Most mothers (99 per cent) are in their first marriage. Fifty per cent of them had married by 20 years of age. This figure is lower than that of the mean age at marriage

estimated for the country as a whole (24 years in 1981) mainly because of selectivity and censoring; selectivity bias arising from taking only married women with at least one child aged 3-36 months at the time of the survey; censoring bias arising from a certain proportion of women being still single at the time of the survey. The median age at marriage for urban mothers is 22.1 years while for their rural counterparts it is 20.9 years and for the estates 20.4 years. These differentials are, however, small and statistically insignificant.

Marriage patterns in Sri Lanka have changed over the years with an increasingly high proportion of men and women marrying late. Yet marriage is still universal; for instance, at the last population census in 1981 the observed proportion of women remaining single by age of 50 was six per cent (Department of Census and Statistics, 1986). For the sample of children for which anthropometric measurements were taken, the overwhelming majority of their mothers (97.4 per cent) were currently married and living with their husbands. This high proportion currently married is not only a reflection of the nature of the sample — mothers with births in the 3-36 months before the survey — but also a reflection of the high degree of marital stability prevailing in Sri Lanka. The proportion of marital dissolutions as a result of divorce or separation (2%) or death of the husband (0.6%) is negligible. Marital dissolutions due to divorce or separation are slightly more frequent in rural and estate settings than in urban areas but the proportions are still negligible (Table 4.1). Although Buddhism and Hinduism, which are the religions professed by the majority, do not have a direct influence on the marriage institution, both these religions favour stable marriage; this may largely explain the relatively high level of marriage stability in Sri Lanka. In his comparative analysis of WFS data Smith (1981) noted a considerably high level of marriage stability among women in Sri Lanka and Thailand, another country with a majority Buddhist population. The stability of marriage was found to be greater in Sri Lanka than in Thailand.

As noted earlier, Sri Lanka has also achieved rapid improvements in longevity. This has reduced the incidence of widowhood in the population. The improved

Table 4.1 Per cent Distribution of Socio-economic Characteristics of Mother and Father by Urban, Rural and Estate Residence (base=number of mothers)

Characteristic	All	%	Urban	Rural	Estate
Weighted N	**1923**	**100.0**	**260**	**1544**	**119**
Current marital status	**ns**				
Currently married	1873	97.4	99.0	97.0	98.1
Divorced/separated	39	2.0	0.3	2.5	1.1
Widowed	11	0.6	0.7	0.5	0.8
Level of education of mother	***				
No schooling	169	8.8	3.3	7.6	36.6
Primary	556	28.9	19.3	29.1	47.8
Secondary	706	36.7	43.0	37.6	11.0
Higher	493	25.6	34.4	25.7	4.6
Level of education of father	***				
No Schooling	133	7.0	4.5	7.0	10.8
Primary	516	26.8	9.6	27.3	58.9
Secondary	745	38.7	41.7	39.6	21.8
Higher	529	27.5	44.2	26.1	8.5
Level of education of parents	***				
Both primary or less	441	22.9	10.1	21.9	64.3
One secondary other lower	414	21.5	13.9	22.6	24.0
Both secondary	372	19.4	25.0	19.6	2.9
One higher than secondary and other lower	371	19.3	23.3	19.8	4.6
Both higher than secondary	325	16.9	27.7	16.1	4.2
Occupation of mother	***				
Not working	1625	84.5	88.5	89.4	12.3
Agricultural occupation	146	4.6	0.3	2.8	86.5
Other occupation	152	7.9	11.2	7.9	0.8
Occupation of father	***				
Administrative, clerical and related work	247	12.9	25.8	11.3	15.0
Other formal sector occupation	316	16.4	26.6	15.6	15.2
Skilled work	342	17.8	25.7	17.5	3.9
Unskilled work	382	19.8	20.0	20.7	8.2
Agricultural work	636	33.1	1.9	34.9	77.7
Religion of mother	***				
Buddhist	1585	82.4	67.8	90.0	15.6
Hindu	113	5.9	4.8	0.9	73.4
Muslim	103	3.3	13.4	4.3	0.8
Roman Catholic and other	122	6.3	14.1	4.7	10.2

ns = Not significant ** = Significant at $p < 0.001$

longevity of people is reflected in the pattern of co-residence as well; at the time of the SLDHS, more than a third of families were living with either the wife's or the husband's parents. Most marriages in Sri Lanka are of *diga* type: the bride moving to husband's household as opposed to the *binna* type where the groom moves to the bride's household, a practice common in *Kandyan* areas; co-residence with the husband's parents is the most prevalent. A substantial proportion of couples (68 per cent) in the childbearing ages in the study sample with children whose anthropometric measurements were taken, had lived with either the husband's or the wife's parents at some time after marriage-for at least six months. This proportion is higher among the urban (71%) than the rural (58%) and estate (38%) areas. A recent micro level study conducted in the south-west part of Sri Lanka about the same time as the SLDHS confirms the existence of a high level of co-residence whereby about three-quarters of the couples were living with the parents (Caldwell *et al.*, 1989).

However, the proportion of couples currently co-residing is 30 per cent for the sample as a whole. This, although, still high, is indicative of a movement towards greater independence by the couples. Yet in the urban areas more than half of the families were living with the parents of one spouse or the other, as shown in Table 4.2, which is somewhat higher than in the other two areas. The reasons for this pattern of high co-residence in general and the higher levels observed in the urban areas have not been properly investigated but they could be mostly economic: a shortage of housing, care for the children and the difficulty of supporting two separate households.

4.3 Parental Education

The expansion of education in Sri Lanka has perhaps been the main social force responsible for the rapid changes in the socio-economic and political life of the nation. The expansion of education began even before independence in 1948 for by 1939 the country was on its way to universal free education (Snodgrass, 1966). Since independence the expansion of education has continued at a rapid rate; the current literacy rates of 98 per cent for males and 85 per cent for females (Department of

Table 4.2 Per cent Distribution of Socio-economic Characteristics of the Household by Urban, Rural and Estate Residence (base= number of mothers/households)

Characteristic	All	%	Urban	Rural	Estate
Status of co-residence	***				
Living with parents	755	29.6	50.6	38.3	26.3
Not living with parents	1168	70.4	49.4	61.0	73.7
Material of construction					
(a) Wall	***				
Brick	1045	54.3	78.3	49.0	73.5
Mud	878	45.7	26.7	50.0	26.5
(b) Floor	***				
Cement	1061	55.2	87.1	52.0	26.2
Mud	862	44.8	12.9	48.0	73.8
(c) Roof	***				
Tiled/Asbestos	957	49.8	69.1	48.0	20.3
Thatched/Zinc Sheet or waste materials	966	50.2	30.9	51.0	79.7
Housing Type	***				
Type 1	718	37.3	62.4	35.3	8.5
Type 2	343	17.9	24.6	16.7	17.7
Type 3	269	14.0	3.4	13.0	50.4
Type 4	593	30.8	9.5	35.0	23.4
Toilet facilities	***				
No toilet	381	19.8	4.0	19.5	58.4
Sanitary toilet	747	38.8	79.8	32.0	34.1
Other toilet:					
Exclusive Use	690	35.9	10.2	42.0	2.4
Shared Use	105	5.5	6.0	5.4	5.1
Source of drinking water	***				
Pipe	159	8.2	35.9	3.0	1.5
Public tap/tube well	217	11.3	21.1	5.6	6.6
Protected well	809	42.1	32.4	46.0	6.6
Unprotected well	577	30.0	9.7	35.0	1.9
River/stream/tank etc.	161	8.4	0.9	9.0	13.4

*** significant at $p < 0.001$

Census and Statistics, 1986) stand out as very high levels by Third World standards.

4.3.1 Level of education of mother

For the sample as a whole, more than half the mothers had at least secondary education. A third had an educational level of primary or less (five years of schooling

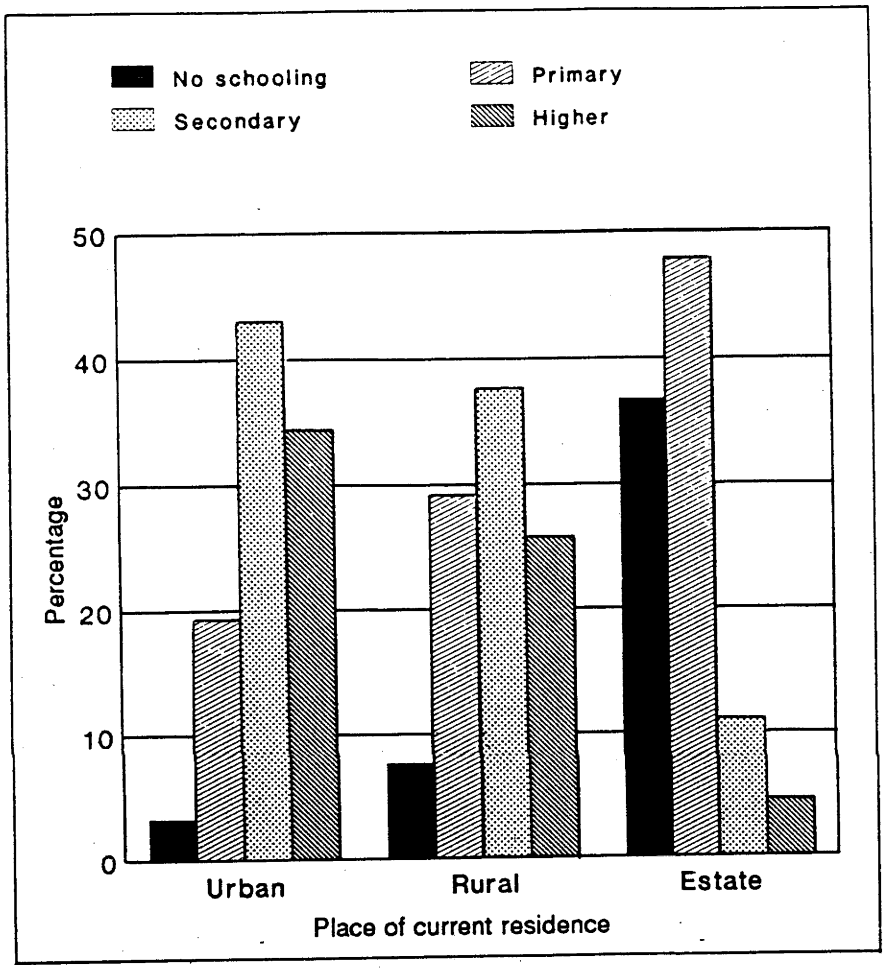

Figure 4.1 Percent distribution of mothers according to level of education by residential area.

or less). Despite an expansion in universal free education, one in every ten mothers in the study population had never been to school.

There are wide differences in educational attainment according to socio-economic background, the more obvious difference being between the urban, rural and estate sectors. The level of education measured in years of schooling shows that urban mothers are the best educated while estate mothers are the least educated. The educational level of rural mothers is midway between the two. For example, the proportion of mothers without any formal education is only 3 per cent in urban and 8 per cent in rural areas; it is as high as 37 per cent in the estates (Figure 4.1). Similarly,

the proportion of mothers with higher than secondary education reaches 34 per cent in urban areas, 26 per cent in rural areas, and barely 5 per cent in the estates (Table 4.1).

Until 1980, when the government took over the responsibility, the provision of education to estate children was vested in the estate management, who provided formal education mainly up to primary level with largely inadequate facilities. Since 1980 the situation has improved and many estates now have classes up to secondary level although the available facilities are less than satisfactory. In estates school enrolments are also poor, partly due to grown up children being given the task of looking after the younger children and partly because they too are used for income-generating work for the family e.g. weeding.

4.3.2 Level of education of father

Fathers in general show a better level of education than mothers in all three residential areas (Table 4.1). The estate fathers stand out in this respect; those with no formal schooling constitute about 11 per cent, less than a third of the figure for mothers; almost a third of the fathers in the estates have at least secondary level education, twice the proportion found among the mothers. Urban fathers tend to be better educated than those in the other two sectors. Rural fathers have a level of education lower than that found in the urban sector but substantially higher than in the estates. There are variations in the level of education between socio-economic zones: zone 5 with a high estate population generally records low levels of education (Table A.4.1, appendix). Socio-economic zone 7, where rainfed farming is prevalent, also achieves a relatively low level of education.

4.3.3 Level of education of parents

The pattern of educational levels of the population among the study population is more clearly evident when the education of mother and father is considered jointly; nearly a quarter of the households had both parents with less than five years of schooling. This proportion is extremely high in the estate areas (64 per cent) which is about six times

the urban level (10.3 per cent) and nearly three times the rural population (Table 4.1). In 17 per cent of the couples both mother and father had higher than secondary education. This group is more common in the urban sector (28 per cent) and not surprisingly the lowest in the estates (4.2 per cent). Where the levels of education in terms of years of schooling differ between the spouses, the husbands are more likely to possess a higher educational level than the wives. Educational differentials of parents between the zones are basically similar to those of urban, rural and estate patterns, most urbanized zones showing couples with better educational levels and zone 5 showing poor levels. Among the non-estate zones, zone 7 again shows a relatively poor level of education.

4.4 Employment and Occupation

In the SLDHS the respondents were questioned about their employment and that of their spouses. The majority of the mothers (85 per cent) were reported as `not working'. The pattern of employment among mothers differs distinctly between residential areas, particularly between the estates and the rest: the `not working' proportion is similar (89 per cent) in urban and rural areas but the overwhelming majority (88 per cent) of the estate mothers are working mainly in agricultural occupations: tea plucking, rubber tapping and related work (Table 4.1). Little over a third of all fathers are engaged in agricultural work while a further 38 per cent were basically engaged in manual work whether it required a particular skill or not. About 13 per cent were engaged in administrative, clerical and related occupations; a further 16 per cent were working in diverse occupations in the formal sector. More than half of the urban fathers were formal sector employees (26 per cent administrative, clerical and related and 27 per cent in other formal sector occupations). In estates the main economic activity of the fathers is obviously plantation agriculture (Table 4.1).

4.5 Housing and the Environment

Housing type, the number of rooms, and the amenities or the facilities available have long been considered proxies for the standard of living of a population. The SLDHS collected a limited amount of information on housing which can be used to determine at least in a broad sense the housing and other environmental conditions — these include the source of drinking water and the availability of toilets relating to a household. The housing information available relates to the materials of construction of the wall, roof and floor. For the roof a little over half had used poor quality materials, but the majority of the houses had brick walls and cement floors (Table 4.2).

Housing characteristics vary widely between urban, rural and estate areas and between socio-economic zones. In general, the materials used for the construction of the wall, roof and floor are better in urban areas; however a higher proportion (78 per cent) of estate houses had good quality walls than those in rural areas (49 per cent). By contrast, nearly two thirds of the estate houses had mud floors. The materials used in the construction of roofs are also worse in estates than in the rural houses.

Estate housing is quite different from that in the rural and urban areas. The provision of basic amenities to the estate labour population is the responsibility of the estate authorities and the residential quarters commonly given to the estate workers are called `line rooms': a large hall is divided by walls into about 10 separate rooms each of which is given to one household. Most of the `line rooms' have brick walls because partition of rooms is done with brick walls. Similar variations are seen in the materials of construction of the wall, roof and the floor between socio-economic zones (Table A.4.1, appendix); there again the rainfed areas of the dry zone (zone 7) stands out with a large proportion of houses with mud floors and thatched roofs. Considering such aspects as the construction materials, the general socio-economic condition of the three sectors, and on the basis of *a priori* observations on the housing and socio-economic characteristics of the population in the different parts of the country, one can safely assume that any house with a tiled or asbestos roof, brick (or solid) walls and a cement

floor is a reasonably good house by Sri Lankan standards. At the other end of the scale is the very poor house with a mud floor, mud walls and a thatched roof, which is the house of the typical poor of the country. In fact, most Sri Lankan houses of the rural poor are constructed of wattle and daub. Between these two extremes, good houses and poor houses, there are houses with different combinations of wall, roof and floor materials: the presence of various such combinations makes it difficult to grade these houses into suitable categories to demonstrate the levels of living of the inhabitants.

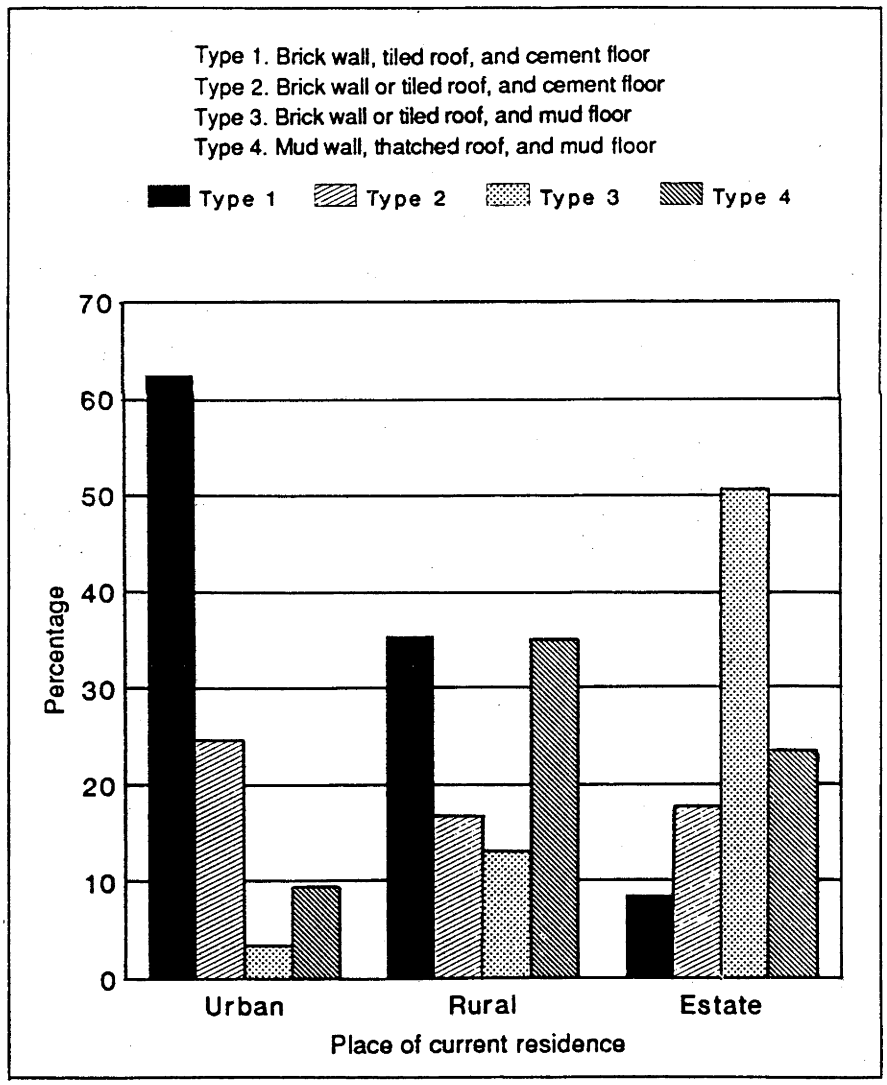

Figure 4.2 Percent distribution of household according to type of housing by residential area.

The materials of construction of the walls and floor are a useful guide but are not equally applicable to all the socio-economic sectors; for instance, most estate sector

houses have good quality walls but not cement floors. One practical way of categorizing such housing units is to go by the materials of the floor, which is an important factor in the study of child survival. A child living in a house with a mud floor is more likely to sleep on a mat on the floor and is more likely to suffer from respiratory infections than a child living in a dwelling with a cement floor. This is particularly true for the estate sector as the climate is cold and respiratory diseases are the major cause of morbidity and mortality among children. Accordingly, taking the materials used for the floor, these houses can be classified into two: those with a cement floor with either a mud wall or a thatched roof or both, and those with mud floors but with either a tiled/asbestos roof or brick walls or both. If this classification is used, then the urban sector has the highest proportion (62 per cent) of houses which meet the criteria of a good house (defined here as type 1) followed by the rural sector (35 per cent). The estate sector has only a small percentage of such houses (Table 4.2). The `type 2' houses, with cement floors and either a mud wall or thatched roof or both, are somewhat more common in urban areas (25 per cent) than in rural and estate areas. The `type 3' houses, those with mud floors and either the roof or the walls made of a good material, are more common in the estates (50 per cent), less prevalent in rural areas and rare in urban areas. The `type 4' houses, those are of poor quality, are mainly found in rural areas followed by the estates (see Figure 4.2).

4.6 Toilet Facilities

Often highly related to the type of housing, toilet facilities or the type of toilet available for the households is also to a large extent a reflection of the socio-economic level of the inhabitants. For the anthropometric sample as a whole, a fifth of the households did not have any toilets. About two in every five households, however, has a sanitary type toilet: water-seal or flush type. The remaining households (42 per cent) have either pit type or bucket type toilets, some of which are shared with the households (Table 4.2 and Figure 4.3).

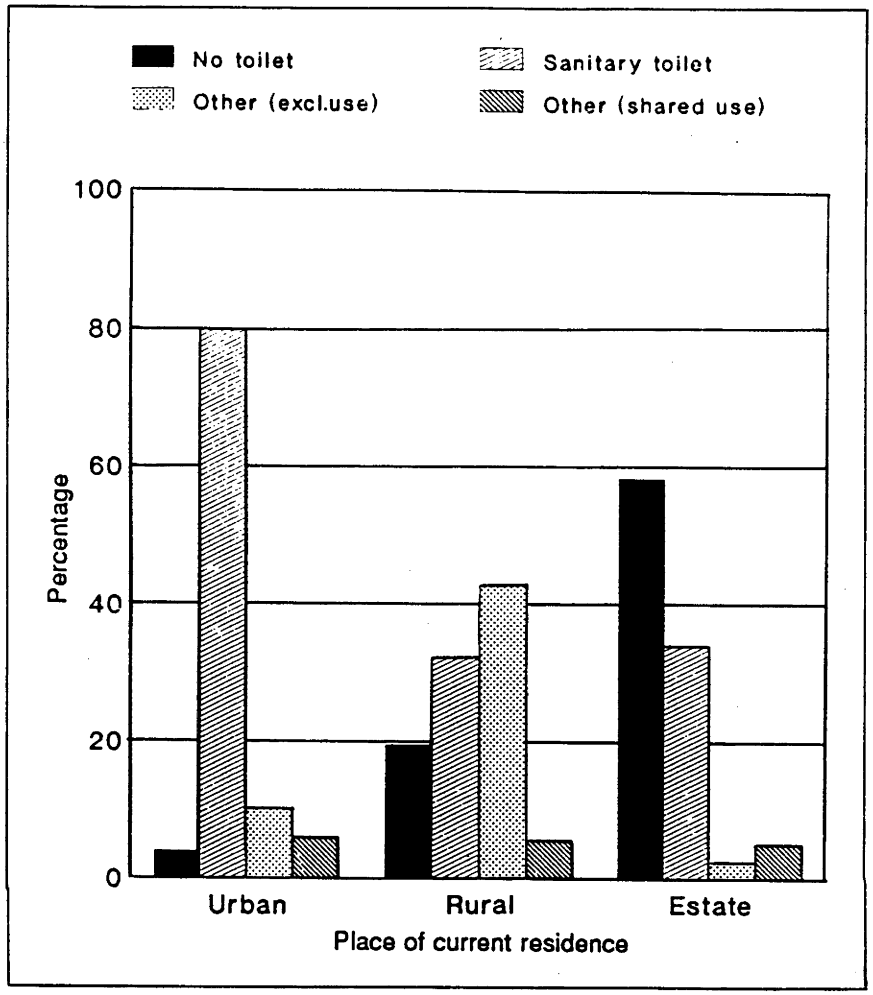

Figure 4.3 Percent distribution of households according to toilet facilities by residential area.

The availability and the type of toilet available as shown in Table 4.2 differ significantly between the urban, rural and estate sectors. More than half (58 per cent) of the estate households do not have a toilet. The proportion with no toilets are very low (4 per cent) in urban areas; but is sizeable (20 per cent) in rural areas. Sanitary type toilets are more common in urban areas where one in every three urban households has a sanitary toilet. Although most estate sector households do not have toilets, when toilets are supplied to the estate population they are more likely to be sanitary toilets. In rural areas bucket-type or pit-type toilets are the commonest.

Among socio-economic zones, apart from Zone 5, households with no toilets are more frequent in rainfed areas of the dry zone: nearly 50 per cent of households.

Sanitary toilets are common in zones 1, 2 and 3 where the urban population is largely concentrated.

4.7 Source of Drinking Water

For most mothers, water for drinking purposes is within reach; about 60 per cent of the households state that it do not take more than 15 minutes to get to a water source; only 13 per cent report walking for more than 30 minutes. This was reported by about 25 per cent of the mothers in the dry zone and about an equal proportion in the estate areas. In urban areas the proportion reporting more than 30 minutes to get to the water is extremely small (2 per cent). A small proportion, about 8 per cent, have access to running water from a pipe in the housing unit, while a further 11 per cent have piped water outside the unit. For the total study population the major source of supply of drinking water is the well; 42 per cent have a protected well (wells surrounded by a wall by raising the edge to prevent flood water getting in — according to the sanitary regulations the raising of the wall should be at least three feet high), while a further 30 per cent have water drawn from unprotected wells. Households mainly dependent on sources such as springs, rivers and ponds for their drinking water make up 8 per cent of the total.

Piped water in the unit is mainly accessible to urban households while a further a fifth have access to street taps. Of urban sector households the overwhelming majority (about 90 per cent) receive water from a safe source: from a pipe, a tap or a protected well. In rural areas the main source of drinking water is the well which is used by slightly more than 80 per cent of households: 42 per cent are, however, unprotected. Households using drinking water from unprotected wells are concentrated predominantly in the less urbanized and less developed socio-economic zones: mainly zones 3, 4 ,6 and 7; piped water, whether inside or the outside the unit, is mainly available in zone 1. Nearly two thirds of the estate households, reported access to piped water but they were mainly outside the unit — mostly a common tap. Even when they get water from a tap the source may not necessarily be safe i.e.sometimes tap-water is

drawn from polluted streams. A notable proportion of estate mothers reported drawing water from miscellaneous sources such as ponds and streams.

4.8 Prevalence of Diarrhoea

The SLDHS probed as to whether any of the children under the age of five years in the household had diarrhoea in the four weeks and the two weeks before the survey. The criterian of whether the child passed stools three or more times a day was used to determine the prevalence of diarrhoea. Despite the obvious problems of obtaining high-quality data on diarrhoea in cross-sectional survey interviews, particularly in areas where it is a common childhood disease, about 10 per cent of the housing units reported that their children had diarrhoea during the reference period(s). The reported diarrhoea prevalence in the households is somewhat greater (11 per cent) in the urban areas than in the rural or estate areas, which each reported about 9 per cent. These differentials are not statistically significant and it is also probable that the slightly higher prevalence in urban areas may be a result of a better reporting, as a result of better educational levels and better understanding of diseases, rather than higher prevalence of diarrhoea than in other two areas.

4.9 Utilization of Health Care

4.9.1 Ante-natal care

With regard to ante-natal care relating to the index child (in the present case the child whose anthropometric data are available), three basic behavioural characteristics are worth investigating: whether, when the respondent was pregnant with the index child, at least one dose of vaccination was received to prevent tetanus; whether the Family Health Worker (FHW), formerly known as Public Health Midwife, visited the mother at least once regarding the pregnancy; and whether the mother went at least once to a clinic or to a doctor for a pregnancy check-up.

The state has provided free health services to its people for several decades, even before independence. In the estate sector, however, the provision of health and

medical care to the inhabitants was the responsibility of the estate authorities. It was only after the Land Reform Laws of 1972 that the estate population also became beneficiaries of the state public health and medical facilities. A surprisingly high proportion (86 per cent) of mothers have received some form of pregnancy care, either by the FHW visiting them or by the pregnant women visiting the ante-natal clinics. It is difficult from the SLDHS data to determine the type and quality of ante-natal care, or the level of competency of the person who examined the mothers, but the extent of use by pregnant women can be assessed. In about 86 per cent of the cases the woman had received at least one dose of tetanus toxoid vaccination. These proportions do not differ significantly between the urban, rural and estate areas (Table 4.2) or between socio-economic zones (Table A. 4.2 Appendix).

The vast majority (96 per cent) of pregnancies had been checked by a doctor or a paramedic. Urban percentages are slightly higher than those for the other areas. There are variations by socio-economic zone: the dry zone areas differ notably in that about 10 per cent of pregnancies in the rainfed part and about 5 per cent in the irrigated part had not been seen by a medical person (Figure 4.4). Although a very high proportion had sought pregnancy check-ups at the clinics, the proportion of pregnancies seen by the FHWs in their regular home visits was smaller than anticipated (66 per cent). In urban areas, particularly in the areas coming under municipal councils, the FHWs of the Ministry of Health do not make home visits but even in rural areas this proportion is not particularly high (69 per cent). Understandably, the coverage of the estate population, although it has improved remarkably since the middle of 1970s[1] is still less than satisfactory: only 43 per cent had been visited by the FHW.

When the FHW visit and the clinic visit are taken jointly, it is clear that the mother's contact with the clinics (or doctors) is greater than that with the FHW in the area (Table 4.3). This is evident in the data relating to rural and estate areas. Little

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1 While drawing attention to the annual report of the Medical Director of Planters Association, Meegama (1982:40) attributes the high neonatal mortality in the estate sector is mainly to inadequate use of antenatal care.

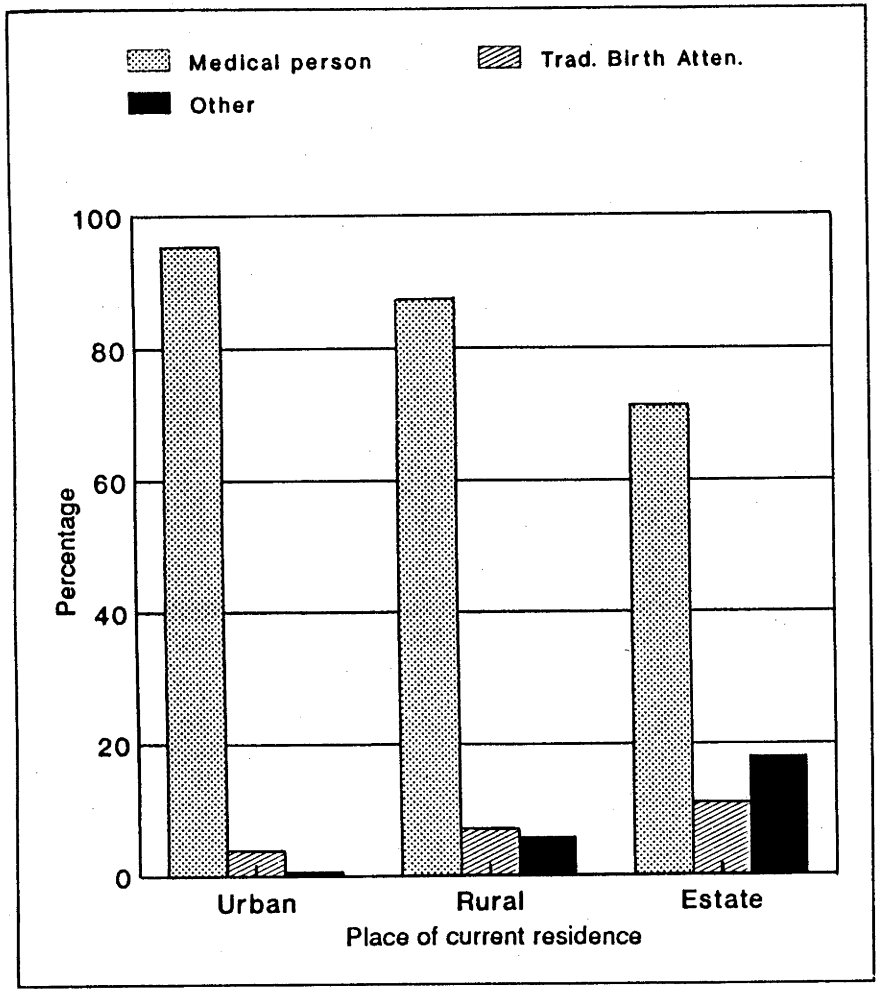

Figure 4.4 Percent distribution of births according to the type of person attending the birth by residential area.

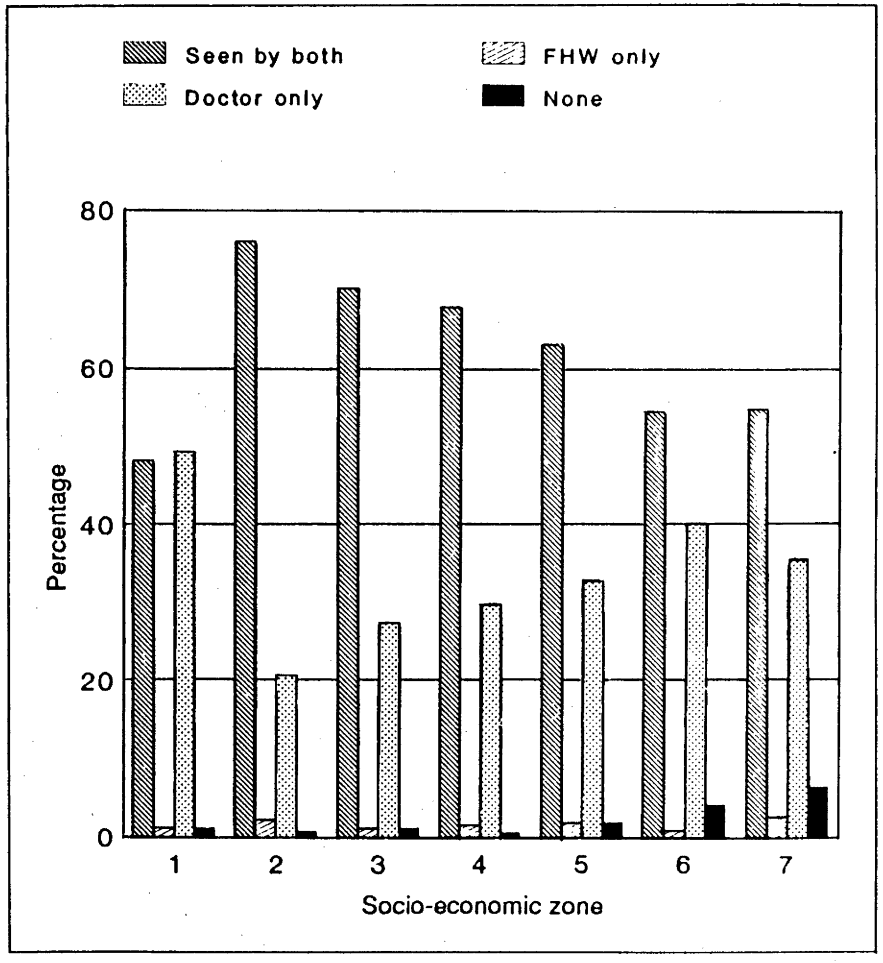

Figure 4.5 Percent distribution of births according to source of antenatal care by socio-economic zone.

more than three fifths of the pregnancies had been checked by both the FHW and a doctor; however, a certain category of mothers, 2.1 per cent, mostly in rural and estate areas, did not receive either of the services (Figure 4.5). Such population groups are most prominent, as shown in Table A.4.2 (appendix), in the dry zone rainfed areas (7 per cent) and in Zone 5 (4.3 per cent).

Most (88 per cent) are institutional births — mainly government institutions. The proportion of children born in an institution is, however, highest (97 per cent) in urban areas and lowest (64 per cent) in estate areas. As most of the births were institutional, the vast majority of deliveries were assisted by a qualified person, either a doctor or a midwife. However, a substantial proportion (about 13 per cent) had been attended by a Traditional Birth Attendant (TBA) or a non-medical person or had taken place without any assistance. About 30 per cent of estate deliveries and a quarter of the deliveries in the dry zone rainfed areas (Figure 4.5) had occurred without medical supervision (Table A.4.2, appendix).

4.9.2 Vaccination and immunization

BCG vaccination, to protect the new born from tuberculosis, is usually given at birth. Overall, 82 per cent had received a BCG vaccination; the high coverage may be due to the large proportion of institutional births. Coverage of BCG is relatively poor in deprived socio-economic zones: about a third of children in zone 5 (mainly estate children), and about a quarter of children in zone 7 (rainfed farming area) have not received the BCG vaccination (see Figure 4.6). In addition to the BCG the Sri Lanka government offers other vaccinations and immunizations covering five disease types: diphtheria, whooping cough, tetanus, polio and measles. To control these diseases three doses of polio and three doses of DPT antigen and one vaccination against measles are provided according to a schedule based on the age of the child. To protect children from these five disease types they should by age 12 months have completed the three doses of polio and DPT (which are normally given simultaneously) and a anti-measles vaccination, given after nine months of age.

Table.4.3 Health Care Behaviour of Pregnant Women and Patterns of Vaccination/Immunization of New Borns by Urban, rural and Estate Residence (percentages are based on number of children)

Behavioural Characteristic	Number of Children	Urban	Rural	Estate	All
Weighted N	1993	264	1599	130	100.0
Ante-natal care					
Whether Tetanus Toxoid given	**ns**				
Given	1705	86.3	85.4	84.9	85.6
Not given	288	13.7	14.6	14.6	14.4
Whether seen by a doctor*					
Yes	1917	98.7	95.8	95.4	96.2
No	76	1.3	4.2	4.6	3.8
Whether visited by a Family Health worker FHW) * **					
Yes	1312	58.0	69.0	42.5	65.8
No	682	42.0	31.0	57.5	34.2
Source of ante-natal care received * **					
Visited by a FHW and visited a doctor/clinic	1278	57.4	67.1	41.4	64.1
FHW only	34	0.7	1.9	1.1	1.7
Doctor only	639	41.3	28.7	54.0	32.1
Neither FHW nor doctor/clinic	43	0.7	2.3	3.5	2.1
Care during delivery					
Place of birth* **					
Institution	1756	96.8	88.6	64.3	88.1
Other	237	3.2	11.4	35.7	11.9
Person assisting delivery * **					
Medical	1740	95.4	87.3	71.3	87.3
Traditional birth attendant	137	3.9	7.0	10.9	6.9
Other persons/No assistance	116	0.7	5.7	17.8	5.8
Vaccination/Immunization B.C.G. * **					
Given	1631	82.4	84.0	53.9	81.8
Not given	362	17.6	16.0	46.1	18.2
For children aged 12-36 months (N=1482) DPT vaccination Dose 3 * **					
Given	1130	74.1	78.7	51.0	76.3
Not given	352	25.9	21.3	49.0	23.7
Polio vaccination Dose 3 * **					
Given	1190	74.1	78.5	51.0	76.1
Not given	292	25.9	21.5	49.0	23.9
Measles vaccination *					
Given	821	52.3	57.0	42.0	55.4
Not given	661	47.7	43.0	58.0	44.6

ns = not significant * significant at $p < 0.05$ *** significant at $p < 0.001$.

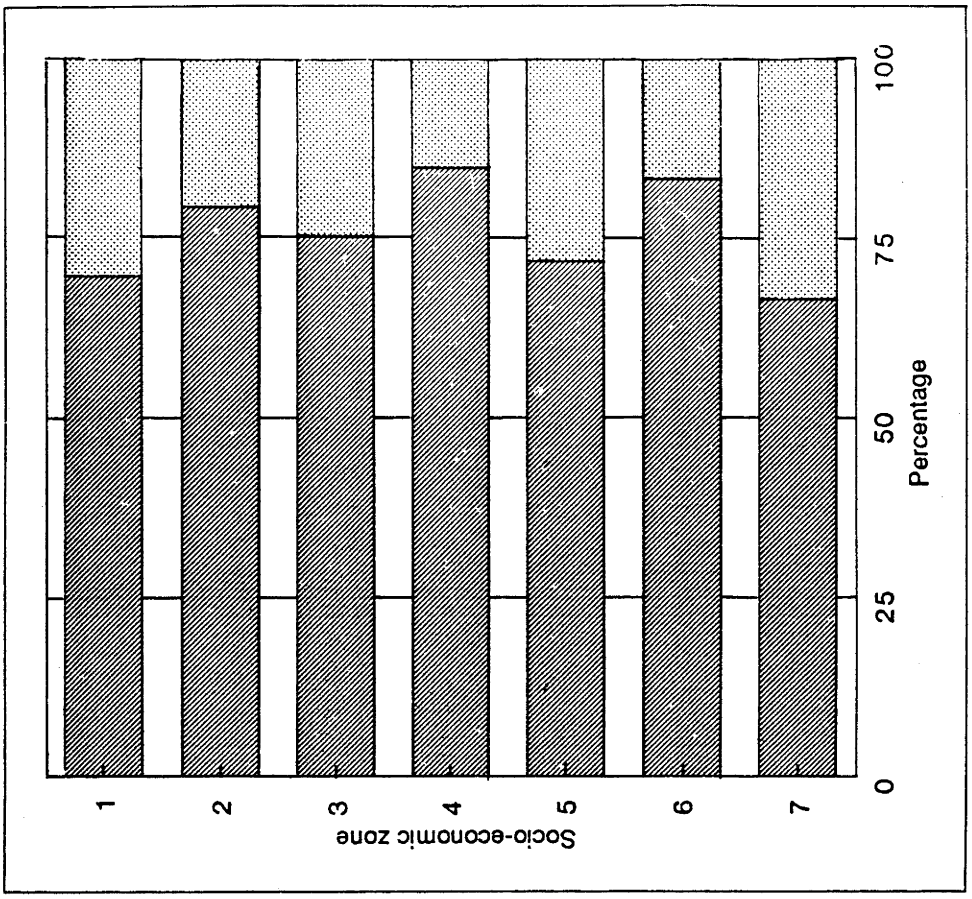

Figure 4.7 Percent distribution of children aged 12-36 months who received DPT3 by socio-economic zone.

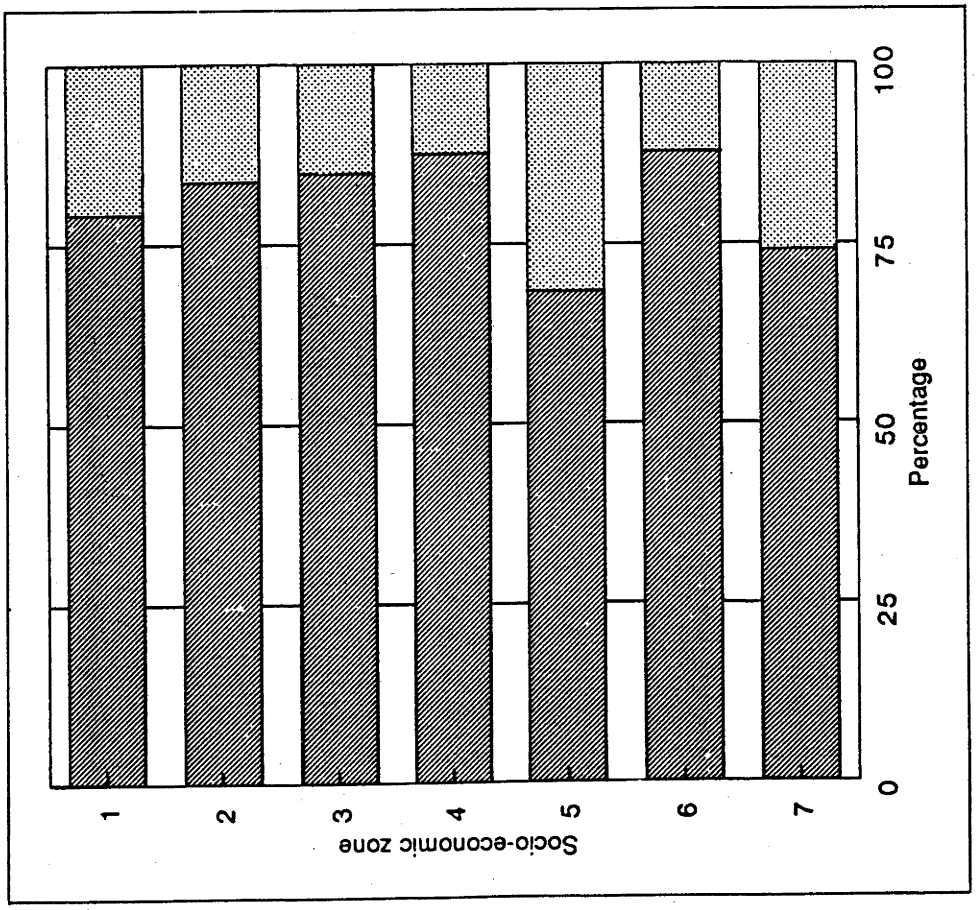

Figure 4.6 Percent of children aged 12-36 months who received BCG vaccination by socio-economic zone.

Among children aged at least 12 months, only 76 per cent had received the third dose of DPT and Polio; the coverage is, however, higher for the rural children (79 per cent) than for the urban ones (74 per cent) and is lowest (51 per cent) for the estate population (Table 4.3). There are wide variations in coverage of polio and DPT immunizations across socio-economic zones. The proportion of children who are aged 12 months or more and received three doses of Polio and DPT is surprisingly low among the children in zone 1. Other zones with relatively poor coverage are zone 7 and zone 5 (see Figure 4.7). Having only recently become available in most parts of the country, measles vaccination has generally a low coverage (55 per cent) at 12 months (Table 4.3).

4.10 Discussion

The foregoing discussion demonstrated the existence of sharp differentials among the population particularly between the urban, rural, and estate areas and the socio-economic zones. Virtually every socio-economic indicator examined pointed to the fact the estate sector differs substantially from the other areas. The other group which consistently showed a low level of socio-economic development consists of those living in zone 7 (inhabited mainly by farmers engaged in rainfed agriculture).

There is thus a need to look at the urban, rural and estate sectors separately without grouping the estates with the rural population as often been done. The classification of seven socio-economic zones basically echoed the socio-economic and behavioural patterns of the urban, rural and estate sectors, with the exception of zone 7, which showed in many respects a disadvantaged situation very different from that of the rest of the rural sector. Therefore, it will be of necessary, for the purpose of this research, to amend the urban, rural and estate sector classification to permit the analysis of the study population of zone 7. This can be done as follows: urban, rural excluding zone 7, zone 7 (rural) and estates.

Level of education of the wife or the husband is used in studies to represent the socio-economic level of the household. In the case of Sri Lanka, however, there are

sharp differentials in the socio-economic behaviour of the people by educational attainment. The level of education of the wife or the husband cannot be used effectively as a proxy for living standards mainly because of the high level of unemployment particularly among the educated. In this circumstance the joint educational level of the spouses seems to be better indicator. It can be used to represent the overall living standards of the household, whether it is directly related to education or not.

In the search for indicators for the standard of living of the household, Meegama (1980) used occupational classification of the father as a proxy for socio-economic status and concluded that, as a proxy it had a limited use. For instance, in the estate sector virtually everybody is engaged in similar occupations while in the other sectors there are vast differences in the patterns of work and work skills and training within individual occupations. In this regard environmental characteristics would perhaps seem to be a better proxy for socio-economic status. As has been discussed, among the environmental characteristics the type of housing appears to be a meaningful proxy for the socio-economic status of a household. In examining household socio-economic status, the type of housing is used in this research as a proxy for the socio-economic status of the household while, where necessary, the level of education of both parents can also be used.

Chapter 5

Levels, Trends, and Differentials in Child Nutrition in Sri Lanka

5.1 Introduction

This chapter has three main objectives. The first is to assess the levels of child undernutrition among the study population according to indicators of nutrition: length for age (stunting); weight for age (underweight); and weight for length (wasting). The second is to illustrate broad trends in child nutrition, by comparison with previous studies, although there are several problems associated with comparability. The third objective is to highlight the patterns of variation in child undernutrition according to the age and sex of the child and to discuss child nutritional status according to socio-economic zones and urban, rural and estate residential sectors. The analysis is restricted to singletons (weighted number 1966) as the multiple births (weighted number 27) showed much higher risks of undernutrition than the singletons (see Table A.5.1, Appendix).

5.2 Child Undernutrition: Overall Levels

For identification of the children who are stunted, underweight and wasted children whose z-scores are below minus 2.00 from the WHO/NCHS are used. Children whose z-scores fall -3.00 or below can be considered as experiencing a severe form of growth faltering (Carlson and Wardlaw, 1990). Estimated prevalence levels of stunting, wasting, and underweight are shown in Table 5.1 together with data on the proportion of severe undernutrition according to the three indicators of undernutrition. For the sample as a whole, 27 per cent of children 3-36 months of age are stunted, their z-scores for length for age being less than -2.00 of the WHO/NCHS standard. About 8 per cent of children (or about 28 per cent of the stunted children) had z-scores -3.00 or below, implying a severe form of growth retardation. About one child in every five is moderately stunted.

Table 5.1 Prevalence of moderate and severe undernutrition in Sri Lanka by indicator of nutrition (singletons aged 3-36 months)

Indicator of nutrition	Per cent undernourished			
	All	Moderate	Severe	Severe as % to total
	(1)	(2)	(3)	(4)=(3)/(1)
Length for age	27.1	19.4	7.7	28
Weight for age	37.2	28.9	8.3	22
Weight for length	11.5	10.9	0.6	5

Note: Children -2.00 SD units and below from the WHO/NCHS median are considered undernourished. Children between -2.00 and -3.01 SD units are defined as moderately undernourished, those -3.00 and below severely undernourished.

The weight for length indicator, by contrast, shows that approximately 12 per cent of children are wasted (low weight for length) and almost all of them are moderately undernourished. The weight for age, a measure of underweight, shows a higher prevalence of both severe (8.3 per cent) and moderate (29 per cent) undernutrition than that of stunting (low length for age). As is seen later in the chapter (see Figure 5.10), the majority of underweight children are stunted. As discussed in Chapter 3, in a situation where stunting is common but most of the children have an adequate weight for length (or height), the weight for age indicator gives an exaggerated estimate of current or recent undernutrition.

Compared to stunting, the prevalence of wasting (weight for length) is low. However, by global standards the observed level of stunting is moderate and wasting is high; in their report of global, regional and country assessments of malnutrition, Carlson and Wardlaw (1990) categorized Sri Lanka, in terms of stunting, with countries having a moderate prevalence (between 20-40 per cent) of undernutrition. In terms of wasting, the same report categorized Sri Lanka along with countries with very high levels of malnutrition: `very high' was defined as a prevalence of 12 per cent or more and `high' between 7 and 12 per cent.[1] In general, a prevalence of wasting above 10 per cent is high (Martorell, 1985).

[1] When all children (inclusive of multiple births) are taken into account, percentage of children wasted slightly exceeds 12 per cent.

5.3 Child Undernutrition: Trends

In Sri Lanka, before the 1987 SLDHS, there were two major studies from which estimates of undernutrition in pre-school children are available from a fairly large sample. One is the Nutrition Status Survey of Sri Lanka (SLNSS) carried out in 1975-76, by the Medical Research Institute (MRI) of the Ministry of Health in collaboration with the Center for Disease Control, USA, and CARE with assistance from USAID. The other is a series of district surveys commenced in 1979 by the Medical Research Institute and concluded in 1982 by the Food and Nutrition Policy Planning Division (FNPPD) of Sri Lanka. In several respects, details of which are given in the Appendix, (A.5.2) the data gathered from the two survey series and from SLDHS are not comparable. For instance the SLNSS did not cover urban areas and the estate areas were covered as part of the rural population but were not treated as a separate sample entity. The survey was conducted at a time immediately after the food crisis and thus may have captured some of the children whose nutritional levels were affected by the unusual conditions.

Both the FNPPD survey and the SLDHS covered urban, rural and estate areas but the sampling procedures adopted for the identification of pre-school children were different. SLNSS used SHS divisions (health adminstrative districts) as the basis of estimation. The FNPPD surveys used administrative districts; the SLDHS used socio-economic zones. The SLNSS concluded the field work in six months, SLDHS in 4 1/2 months. The FNPPD surveys took about three years from 1980 to 1982, except for the Matara and Hambantota districts where the survey work was done by the MRI in 1979. These surveys, by the MRI and FNPPD, were conducted at a time when food and welfare policies were undergoing rapid change which had direct influence on the level of nutrition of children (for details see Appendix A.5.2).

SLDHS did not cover the eastern and northern provinces. Approximately 14 per cent of the population of Sri Lanka lives in these areas, including the majority of Sri Lankan Tamils (72 per cent) and a sizeable proportion of the country's Moor population

(35 per cent).

Despite the problems associated with comparability between the two earlier surveys, Shan (1987) has attempted to compare the results of the 1975-76 survey with those of the 1980-82 survey[2] by estimating undernutrition prevalence using z-score values from the SLNSS data by comparison with the same reference values (NCHS) as in the FNPPD survey.

Table 5.2 presents the data from Shan (1987) for the SLNSS and FNPPD surveys together with the relevant data from SLDHS for a broad assessment of trends over the period (see also Figure 5.1). The data from the three surveys clearly show that among children 6-35 months, the prevalence of stunting is high and its prevalence is extremely high in the estate areas. For instance, in 1975-76, among children 6-11 months old stunting in estate areas was more than twice that in rural areas; in 1980-82 it was nearly three times greater; at other ages the prevalence of stunting in the estate sector is nearly twice the rural prevalence. The data show that the prevalence of stunting has declined from 1975-76 to 1980-82; leaving aside the problems of comparability associated with methodologies and procedures, this phenomenon is mainly a result of the timing of the two-survey series. The 1975-76 survey was conducted following the food crisis year of 1974 and if stunting is viewed as a cumulative process which increases with age (this aspect is discussed later in the chapter), this estimate of stunting includes the children born in the food crisis year, which may have caused the high prevalence levels of that survey.

The lower prevalence rates of stunting in 1980-82 than in 1975-76, however, are a reflection of a `relatively better degree of food security for the poor during [the] 1976-79 period' (Shan, 1987:813). Stunting being a cumulative effect of past nutrition, the prevalence levels were less affected by the radical changes in the food and welfare policies, (discussed in Chapter 1), that were taking place in the 1980-82 survey period (see Appendix A.5.2). Undoubtedly the prevalence of stunting reported in 1987 showed

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2 It is presumed that data for the two districts (Matara and Hambantota) collected by the MRI in 1979 are not included in the data.

Table 5.2 Per cent of children undernourished (-2.00 SD units or below reference median) by age and place of residence, Sri Lanka, 1975-76, 1980-82, and 1987*.**

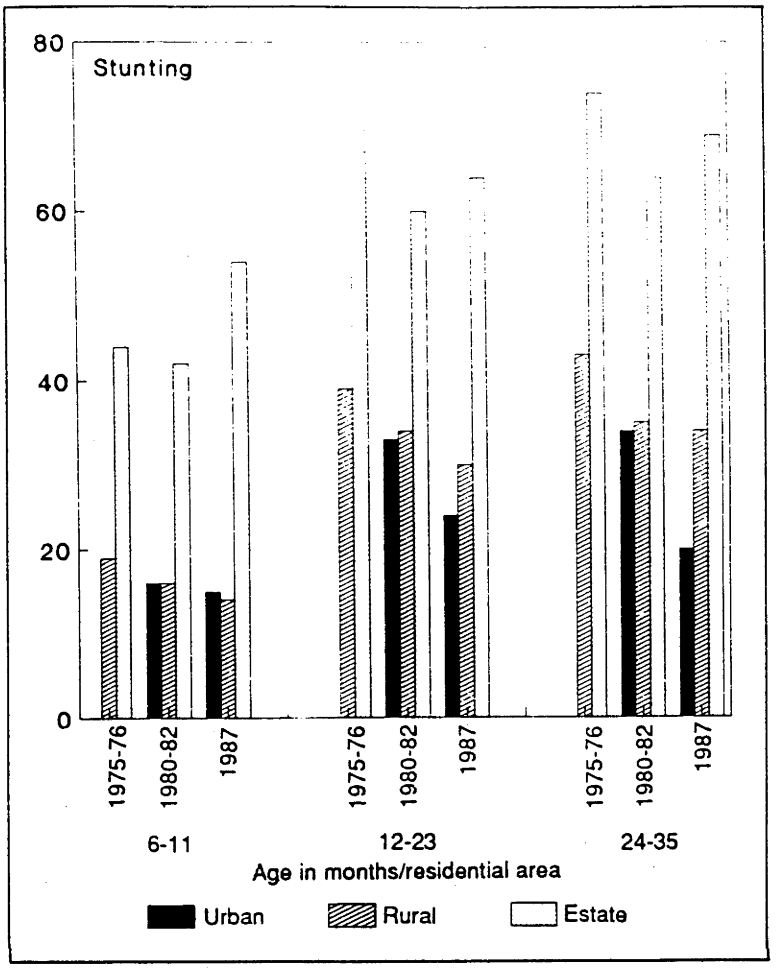
Indicator/ residence	Age group in months								
	6-11			12-23			24-35		
	1975-76	1980-82	1987	1975-76	1980-82	1987	1975-76	1980-82	1987
Stunting (length for age)									
Urban	n.a	16	15	n.a	33	24	n.a	34	20
Rural	19	16	14	39	34	30	43	35	34
Estate	44	42	54	67	60	64	74	64	69
Wasting (weight for length)									
Urban	n.a	12	6	n.a	14	13	n.a	11	12
Rural	6	13	5	18	24	21	10	16	9
Estate	4	14	-	24	25	11	13	18	2

Source: Data for 1975-76 and 1980-82 from Shan (1987) Table 3:814. Data for 1987 from SLDHS.

Note: 1975-76 Survey covered rural and estate areas only. However, estates were not treated as seperate sampling entity.
* excluding northern and eastern provinces
** excluding Matara and Hambantota districts

n.a = not available

For a detailed discussion on comparability between the surveys see Appendix 5.2



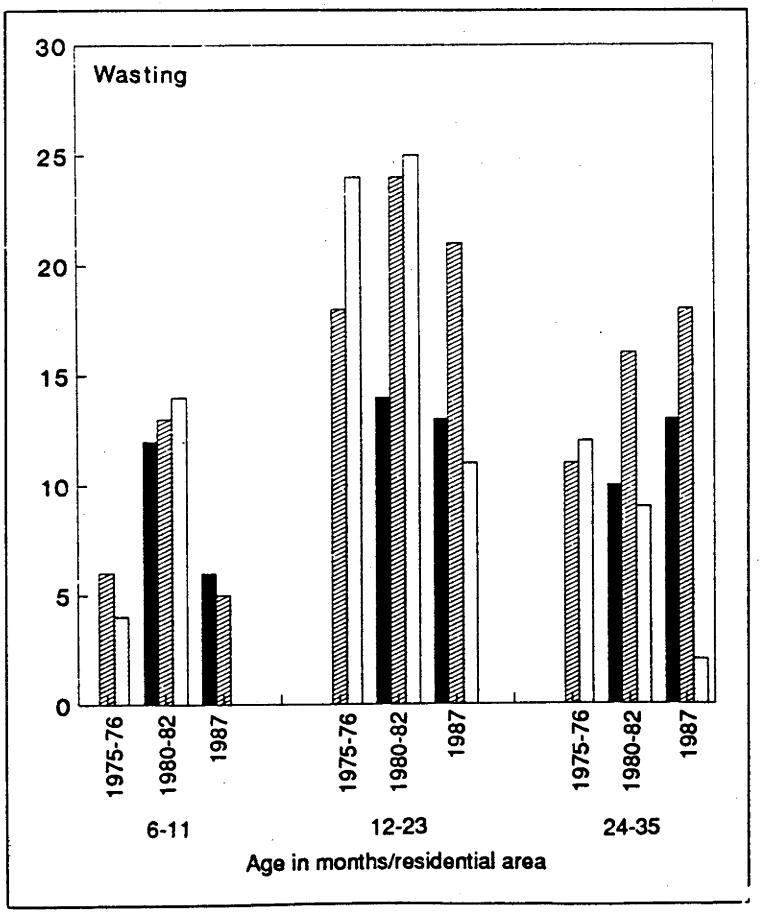


Figure 5.1 Trends in undernutrition among children aged 6-35 months in Sri Lanka, 1975-76, 1980-82 and 1987.

an increase over the 1980-82 period for the estate children (Table 5.2).

SLDHS also confirms the findings of the earlier surveys of a higher prevalence of stunting in the estates than in the other areas, but the reported prevalence of wasting in the estates in the SLDHS is lower in all age groups than those reported in other two areas. Between 1980-82 and 1987 there is however, a substantial drop in the prevalence of stunting among urban children; this trend is seen in all age groups. A similar but less pronounced decline is registered among rural children. Estate children, by contrast, show a declining trend in wasting despite the increase in the prevalence of stunting: the proportion of children stunted increases from 42 per cent to 54 per cent among the 6-11 month group, from 60 to 64 per cent among those in the 12-23 month age group, and 64 to 69 per cent among those 24-35 months. The estate population as a group may have been affected adversely by the changes in the nutritional welfare policy in the early 1980s. It is worth noting that the prevalence level of 54 per cent among the estate children in the 6-11 age group recorded in 1987 is far higher than the (44 per cent) that reported in the 1975-76 survey carried out a year after the food crisis. This is indicative of the nutritional stress of the mothers which may have affected adversely the birth weight of children, and the low level of wasting may be a result of slightly better health care, compared to that which existed previously, among the estate population.

The pattern of wasting varies across age groups and residential areas. Data from all three surveys consistently show that in all residential sectors (in 1975-76 urban areas were not covered), wasting is severe among the children 12-23 months old — a period corresponding with weaning. Prevalence of wasting according to the data (Table 5.2) increased between 1975-76 and 1980-82 and the increase is particularly high in the age group 6-11 months. This may be a result of low nutritional level of infants caused by the deteriorated nutritional status of the mothers. However, the prevalence of wasting is lower in 1987 among all age groups and in rural and estate areas than the levels reported in the 1975-76 and 1980-82 surveys. The declines observed among the estate children are particularly noteworthy.

5.4 Age Pattern of Child Undernutrition

Apart from the factors such as maternal undernutrition which cause growth retardation in children, mainly in *utero* and early infancy, the pattern of growth in children is affected by two main factors: food and nutrient intake, and infections. The type, quantity and mode of feeding vary with age; the prevalence, frequency and intensity of infections are also affected by the factors relating to feeding. Thus both factors are related to the child's age. The age pattern of undernutrition in turn varies with the type of undernutrition studied; as is discussed below, stunting increases with age while wasting increases with age up to a certain age and then begins to decline.

5.4.1 Age pattern of stunting

Irrespective of the nutritional indicator used, the level of nutrition of children begins to fall off, compared to the reference population, in the first half of infancy. Estimated mean z-scores (-0.53) for the 3-5 months old children move rapidly away from the reference mean to -1.15 in the second half of infancy, and continue to fall off as the age increases, with the exception of the 24-29 months age group.

Similarly the proportion of children stunted increases from 7.1 per cent among children aged 3-5 months to 15.4 per cent among children of the 6-11 months group. In conformity with the pattern shown in the mean z-scores, the prevalence of stunting rises with increasing age of child, except in the 24-29 months age group where some sort of `recovery' is observed. The observed lower proportion of stunted children among the children aged 24-29 months than for the two adjacent age groups (see Figure 5.2) is largely a statistical artifact arising from switching the reference base[3] from supine length to recumbent height, rather than a catch-up growth or recovery in length in that

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[3] The data base on which the NCHS reference was based, as already mentioned contains two sources: Fels research data which measured supine length of children under two years, and HES and HANES of the NCHS which measured the standing height of children 24 months and above. When NCHS data which contained the two data sets were normalized in order to permit z-score transformation, it may have minimized the data contamination caused by amalgamating the two data sets with different measurement procedures. Yet it has been shown that the NCHS children are 1-2 centimetres shorter at age 24 months at which age the switch was affected (Dibley *et al.*, 1987).

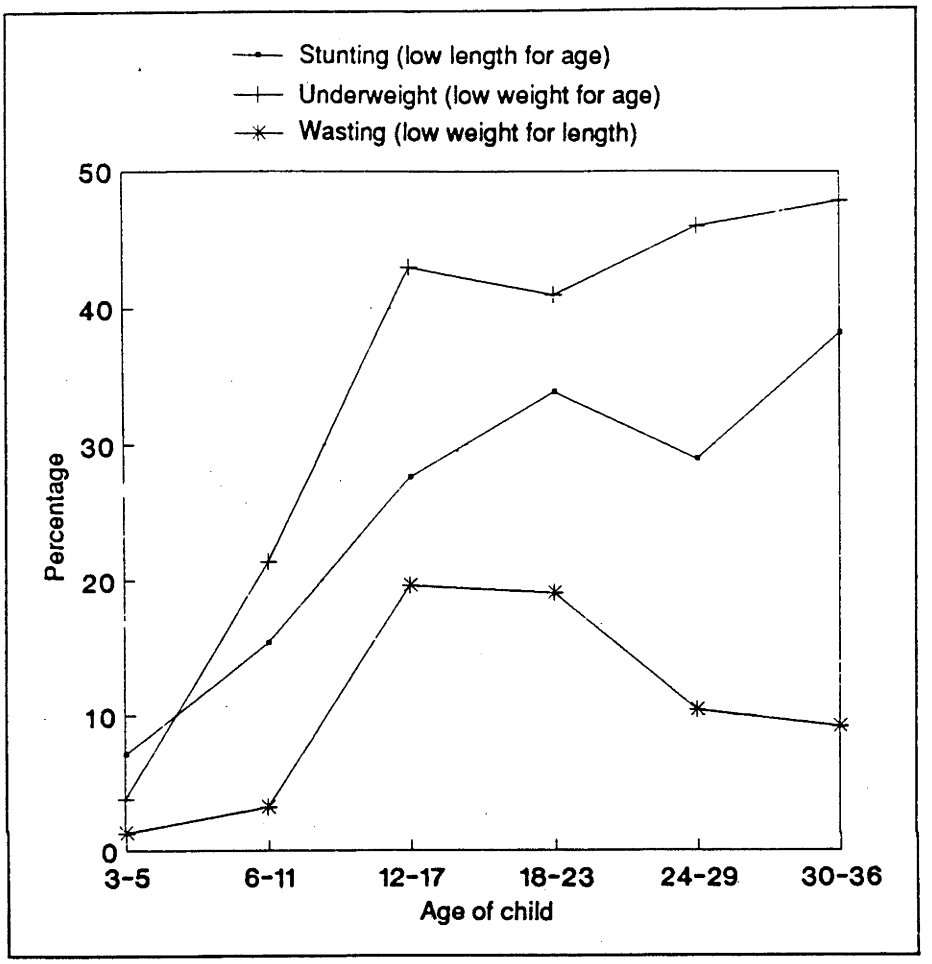


Figure 5.2 Prevalence of undernutrition among children aged 3-36 months according to indicator of undernutrition by age.

age group (Rutstein and Sommerfelt, 1989:4). Although the faltering of growth is seen at the lower end of the age groups (6-11 months), it is not possible from the data to determine exactly at which age the growth faltering is actually taking place, because measurement of length and weight is available only from 3 months onwards; but it could be any time from the late foetal period up to the time of the survey. The observed growth faltering at an early age (3-5 months) also raises the question of the adequacy of breastmilk in the first half of infancy. Studies elsewhere in the developing world have shown that breastmilk alone is not sufficient to guarantee the adequate growth of children from the third month onwards (Waterlow and Thomson, 1979). The increasing prevalence of stunting with age mainly occurs because of insufficient dietary intake

when the child moves from breastmilk to family food at a time of rapid growth demanding extra nutrients (Martorell, 1985; Waterlow, 1985a). Since stunting can occur even *in utero* and continue through the pre-school years, the pattern of increasing prevalence in stunting with age can be considered a cumulative process which has been continuing for some time and, therefore, not necessarily a reflection of a high prevalence of stunting among children at higher ages (Soysa and Waterlow, 1981:1430; Waterlow, 1985a). When a child is affected by stunting at a very early age, recovery is found to be very slow and as a result the child will continue to be stunted through and beyond the toddler years as well (Waterlow, 1978:457).

5.4.2 Age pattern of wasting

Both measures, mean z-scores and per cent undernourished, show that wasting (low weight for length) begins to appear in the first year of life but its prevalence is highest (—1.24) among children 12-23 months of age. The prevalence of wasting thereafter declines and stays below the peak levels (Table 5.3 and Figure 5.2). The pattern of wasting thus corresponds to the age of weaning. When breastfeeding is prolonged, the supply of breastmilk begins to fall short of the nutritional requirement and, if there is an inadequate supplementation, failure to gain weight occurs. When a child is wasted, depending on the severity, it is vulnerable to infections, particularly diarrhoea associated with weaning, which also contribute to weight loss thereby increasing the prevalence of wastage. Unlike stunting, one important aspect of wasting is that it can very quickly affect a child, but recovery can also occur in a very short period of time (Ashworth, 1969). As the age of the child increases it is able to eat adult food and its immune system becomes more effective — accordingly wasting is less common at higher ages.

For each age group the prevalence of low weight for age (underweight) shows a higher level of undernutrition than shown by the other two indicators, stunting and wasting. This is mainly because, as discussed in Chapter 3, weight for age indicator is a composite measure of both length for age and weight for length.

Table 5.3 Prevalence of stunting and wasting by age of child, Sri Lanka, SLDHS, 1987

Indicator	Age of child						
	All	3-5	6-11	12-17	18-23	24-29	30-36
				Mean z-score			
Stunting	-1.36	-0.53	-1.15	-1.47	-1.51-	-1.43	-1.77
Underweight	-1.64	-0.54	-1.41	-1.84	-1.77	-1.86	-1.98
Wasting	-0.98	-0.23	-0.67	-1.24	-1.24	-1.09	-1.12
				Percentage undernourished			
Stunting	27.1	7.1	15.4	27.6	33.9	28.9	38.2
Underweight	37.2	3.8	21.4	43.0	41.0	46.0	47.9
Wasting	11.5	1.3	3.2	19.6	19.1	10.4	9.2
				Number of children			
(Weighted)	1966	212	352	376	244	354	329

Note: Stunting = low length for age; wasting = low weight for length; and underweight = low weight for age.

5.5 Undernutrition by Sex of Child

The pattern of differentials in undernutrition between boys and girls is interesting; in terms of stunting overall mean z-scores for the two sexes are similar but the percentage of children stunted is slightly higher among girls than boys; the differentials are not statistically significant. The pattern of sex differentials in stunting by age is interesting: prevalence of stunting increases (or mean z-scores decline) with age among both sexes but the rate of increase is greater for the girls than the boys. As a result sex differentials in stunting observed in the young ages change in favour of boys after 18-23 months of age (see Figure 5.3 and Table 5.4). For instance the sex ratio of stunting at 3-5 months is 166 per 100 girls. This ratio drops consistently over the rest of the age group: 133 at 6-11 month and 116 at 12-17 months. After 18-23 months the sex ratio of stunting reaches a level below 100.

Sex differentials in wasting show similarities with those observed in stunting but the pattern of differentials by age group is less clear: at young ages girls are less affected than boys by wasting. The relative advantage that girls enjoy tends to reverse after 24 months of age. The prevalence estimates of wasting for the two sexes

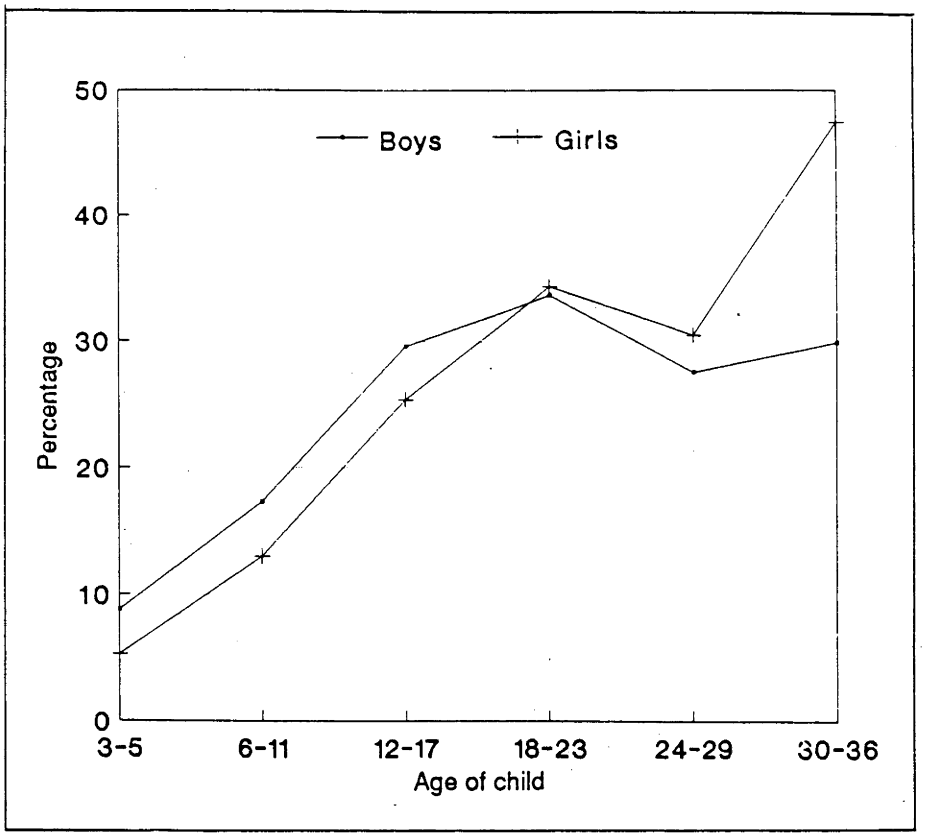


Figure 5.3 Percentage of children aged 3-36 months stunted by age and sex.

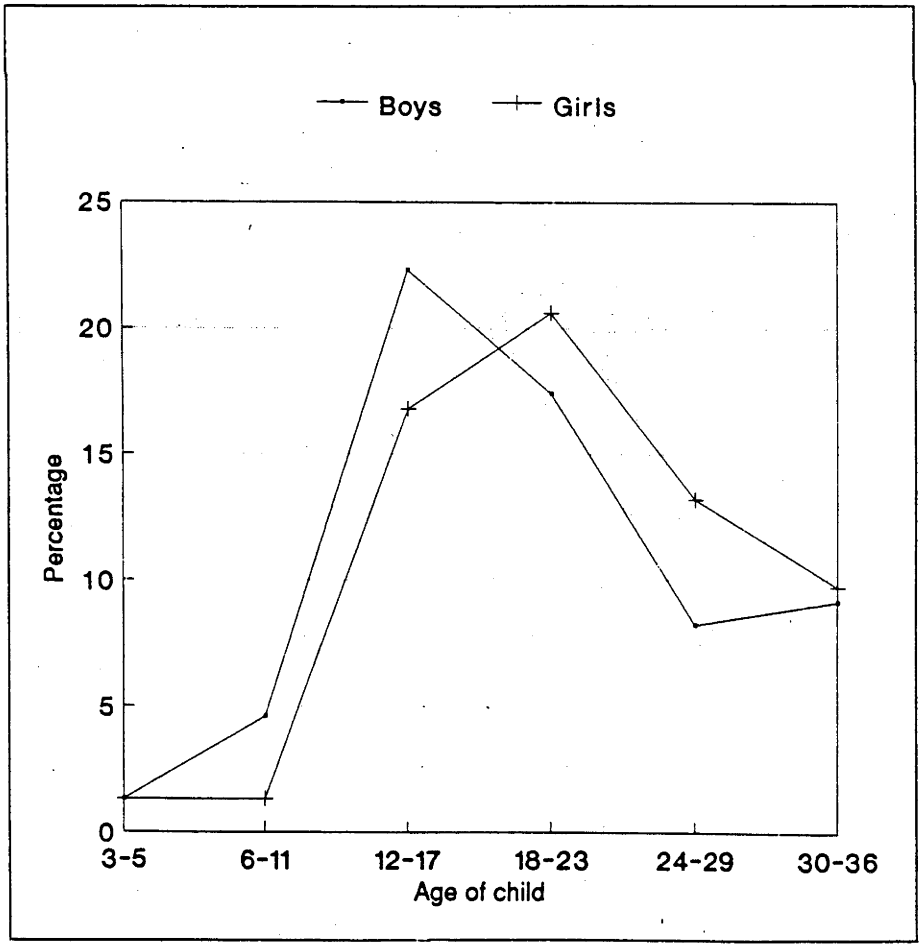


Figure 5.4 Percentage of children wasted by age and sex.

Table 5.4 Prevalence of stunting and wasting by sex of child and age, Sri Lanka, SLDHS, 1987

Indicator/ Sex of child	All	3-5	6-11	12-17	18-23	24-29	30-36
				Mean z-score			
Length for age							
All	**-1.36**	**-0.53**	**-1.15**	**-1.47**	**-1.51-**	**-1.43**	**-1.77**
Boys	-1.36	-0.71	-1.25	-1.49	-1.56	-1.38	-1.55
Girls	-1.36	-0.30	-1.01	-1.44	-1.47	-1.52	-1.99
Weight for age							
All	**-1.64**	**-0.54**	**-1.41**	**-1.84**	**-1.77**	**-1.86**	**-1.98**
Boys	-1.66	-0.73	-1.50	-1.88	-1.82	-1.83	-1.84
Girls	-1.62	-0.31	-1.29	-1.80	-1.72	-1.89	-2.13
Weight for length							
All	**-0.98**	**-0.23**	**-0.67**	**-1.24**	**-1.24**	**-1.09**	**-1.12**
Boys	-1.01	-0.33	-0.75	-1.27	-1.26	-1.09	-1.14
Girls	-0.95	-0.11	-0.58	-1.20	-1.22	-1.10	-1.10
				per cent undernourished			
Length for age							
All	**27.1**	**7.1**	**15.4**	**27.6**	**33.9**	**28.9**	**38.2**
Boys	26.0	8.8	17.3	29.6	33.7	27.6	29.9
Girls	28.4	5.3	13.0	25.4	34.4	30.5	47.4
Weight for age							
All	**37.2**	**3.8**	**21.4**	**43.0**	**41.0**	**46.0**	**47.9**
Boys	37.1	3.8	24.0	47.3	44.4	44.4	39.6
Girls	37.4	4.0	18.2	38.4	37.5	48.5	56.6
Weight for length							
All	**11.5**	**1.3**	**3.2**	**19.6**	**19.1**	**10.4**	**9.2**
Boys	11.4	1.3	4.6	22.3	17.4	8.2	9.1
Girls	11.5	1.3	1.3	16.8	20.6	13.2	9.7
				Number of children			
Boys	1051	116	193	199	173	206	164
Girls	915	96	159	177	171	148	165

show that boys have an early peak (see Figure 5.4), perhaps a reflection of earlier weaning of boys than of girls (as discussed in Chapter 6). Sex differentials in underweight broadly conform with those observed in stunting.

Although the overall differentials between the sexes were not statistically significant, statistical tests (chi square statistics for per cent undernourished and `t' statistics for mean z-scores) were performed to examine whether the differences

observed in nutrition between various age groups are in fact statistically significant. The results are presented in Table 5.5. For both stunting and underweight lower nutritional levels observed among the boys were statistically significant during infancy. At age group 30-36 the differentials were also significant; boys showed a relative advantage over girls. For wasting, differentials were not significant except for the female advantage observed in the second half of the first year. Sex differentials in stunting and wasting among the children differentiated by the mother's education, residential type and religion of the mother were minor and not statistically significant (Appendix Table 5.3).

Table 5.5 Statistical significance of relationships between nutritional status expressed in terms of mean z-scores between boys and girls by individual age of children

Indicator/ Characteristic	All	3-5	6-11	12-17	18-23	24-29	30-36
Length for age							
Boys vs Girls	NS	*	*	NS	NS	NS	*
Weight for age							
Boys vs Girls	NS	*	*	NS	NS	NS	*
Weight for length							
Boys vs Girls	NS	NS	*	NS	NS	NS	NS

NS = Not statistically significant * = Significant at $p < 0.05$

It has been hypothesized that under environmental stress conditions boys are less protected from morbidity, poorer growth and mortality than girls. Frequently cited examples in support of this hypothesis come from Greulich and others (discussed in Stinson, 1985) who studied the growth pattern of children who survived the atomic bombing in Nagasaki and Hiroshima, Japan. They found that, among the survivors, growth and maturation were poorer among boys than among girls. Similar evidence was also reported from Leningrad in the food shortage period during the Leningrad siege (Antonov, 1971 cited in Stinson, 1985).

Stinson (1985) reviewed the available empirical evidence on sex differentials in

growth, morbidity, and mortality to test the hypothesis that males are less buffered than girls against the effects of the environment, and found sufficient evidence in favour of the hypothesis during prenatal growth. The evidence on growth under postnatal environmental stress, however, did not consistently show poorer growth among boys.

The main reason for the inconsistency in the results, according to Stinson, is the possible effect of sex bias in the postnatal period in favour of sons. In some countries, mainly in South Asia, there is evidence of sex preference in caring for and rearing of children: for instance in Bangladesh, Chen, Huq, and D'Sousa (1981) observed intra-family food allocations in favour of boys; while Sen and Sengupta (1983) found in two Indian villages poorer growth among girls than boys due to parental care and feeding behaviour in favour of sons. In Sri Lanka Nadarajah (1983) suspects that the higher mortality among girls than boys that existed in the past was possibly due to son preference:

> preference for sons does not necessarily mean that female children are deliberately ill treated or neglected. They may be subject to relative and probably unconscious neglect compared to male children (Nadarajah, 1983:233).

The differential pattern of growth observed between boys and girls may be a reflection of the advantage that girls inherited from the prenatal period continuing through infancy during which period breastfeeding is carried out without much discrimination between the sexes. After infancy girls experience a more rapid decline in nutritional status than boys possibly because of the intentional or unintentional feeding practices in favour of boys. As is discussed in Chapter 6 there is a pattern, although the statistical significance is weak, of earlier weaning of boys than girls.

5.6 Undernutrition by Place of Current Residence

5.6.1 Socio-economic zone

The nutritional level of the study population varies widely between the socio-economic zone, from 19.2 per cent among children in zone 2 to 42 per cent in zone 5 (Table 5.7). Undernutrition, particularly stunting, is said to be a result of the general poverty of the

Map 4.1

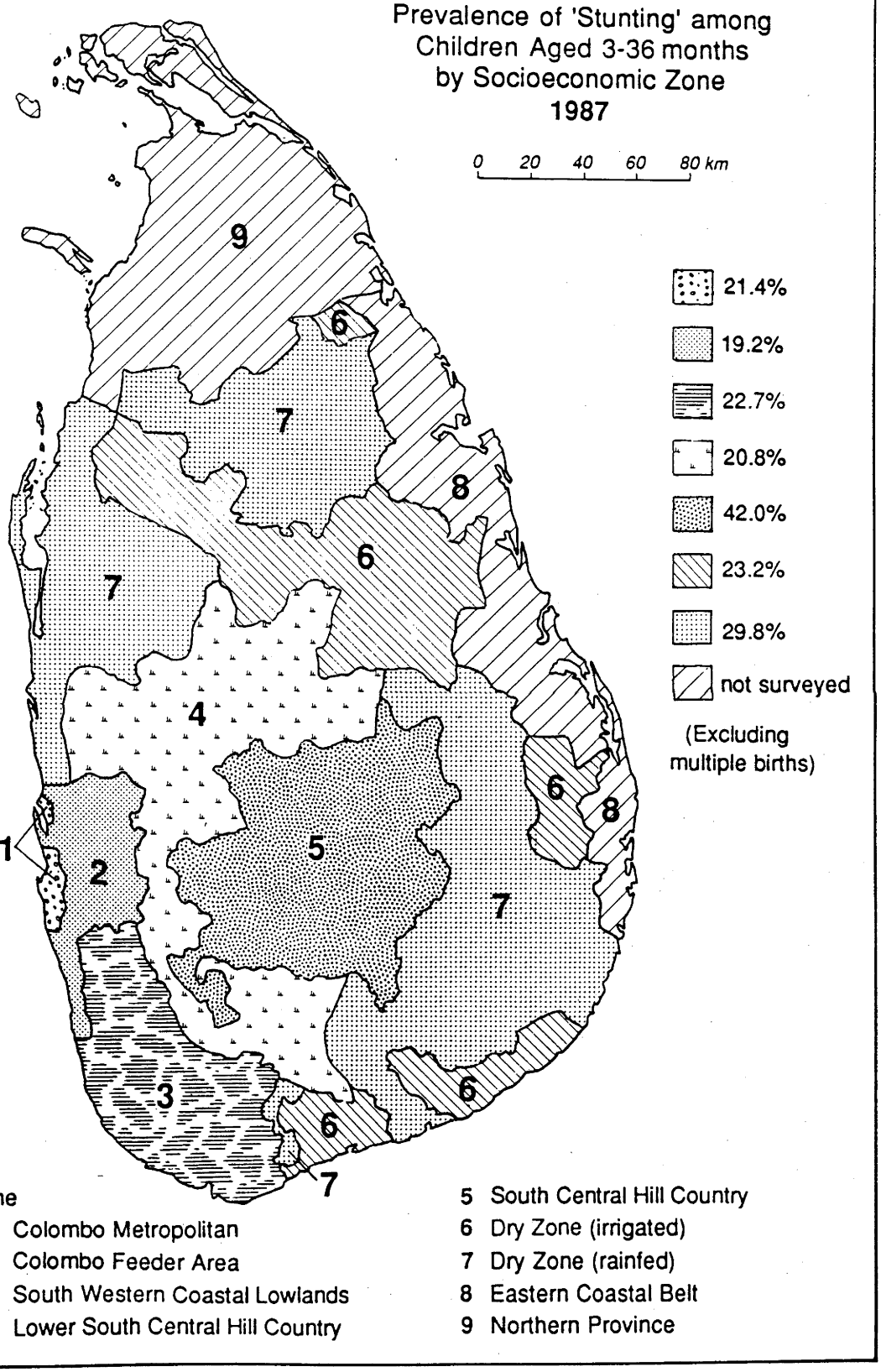

SRI LANKA
Prevalence of 'Stunting' among Children Aged 3-36 months by Socioeconomic Zone
1987
0 20 40 60 80 km
21.4%
19.2%
22.7%
20.8%
42.0%
23.2%
29.8%
not surveyed
(Excluding multiple births)
Zone
1 Colombo Metropolitan
2 Colombo Feeder Area
3 South Western Coastal Lowlands
4 Lower South Central Hill Country
5 South Central Hill Country
6 Dry Zone (irrigated)
7 Dry Zone (rainfed)
8 Eastern Coastal Belt
9 Northern Province

Table 5.6 Prevalence of stunting and wasting among singleton children aged 3-36 months by socio-economic zone and urban, rural and estate areas.

Residence	Weighted N	Prevalence of `Stunting'	Prevalence of `Wasting'
Socio-economic zone		***	***
Zone 1	144	21.4	11.9
Zone 2	256	19.2	10.3
Zone 3	285	22.7	11.3
Zone 4	428	20.8	13.9
Zone 5	451	42.0	7.9
Zone 6	141	23.2	10.1
Zone 7	261	29.8	15.4
Residential sector		***	***
Urban	262	19.1	10.3
Rural (1)	1320	25.0	11.5
Rural (2)	254	30.0	15.9
Estate	130	59.9	4.9

*** Differentials are significant @ $p < 0.001$ based on the chi square statistics.

population. The levels of stunting in different socio-economic zones broadly conform with this hypothesis: stunting in zone 5 is more than twice the level in the two most urbanized and developed zones 1 and 2 (Table 5.6 and Map 1). Similarly the least developed rainfed areas of the dry zone (zone 7) have the second highest prevalence of stunting (see Map 1). The prevalence of wasting across the socio-economic zones however is different from that of stunting; zone 5, which showed the highest prevalence of stunting, is the zone with least prevalence of wasting and socio-economic zone 1 with a low prevalence of stunting records a high proportion of wasting. The prevalence of wasting is highest (15.4 per cent) among the children in zone 7 followed by zone 4 (13.9 per cent), which is in the central hills with a majority of non-estate population (Figure 5.5 and Map 2).

5.6.2 Urban, Rural and Estate Residence

As stated in Chapter 4, in the present analysis the rural area has been divided into two, rural (1), consisting of all rural areas except those in zone 7, and rural (2) which consists zone 7. Data on prevalence of stunting and wasting for the four residential

areas are shown in Table 5.8. Clearly, the differentials in undernutrition are much wider among children differentiated according to the four residential areas. In terms of stunting urban areas show the lowest prevalence. The prevalence of stunting in the estate sector (59.9 per cent) is more than three times and in rural (2) areas one and a half times the urban (19.1 per cent) level. Prevalence of wasting, by contrast, shows a different picture: the lowest prevalence of wasting is found among the estate children followed by the urban. The highest level of wasting is seen among the rural (2) children whose level is approximately three and half times that in the estate areas.

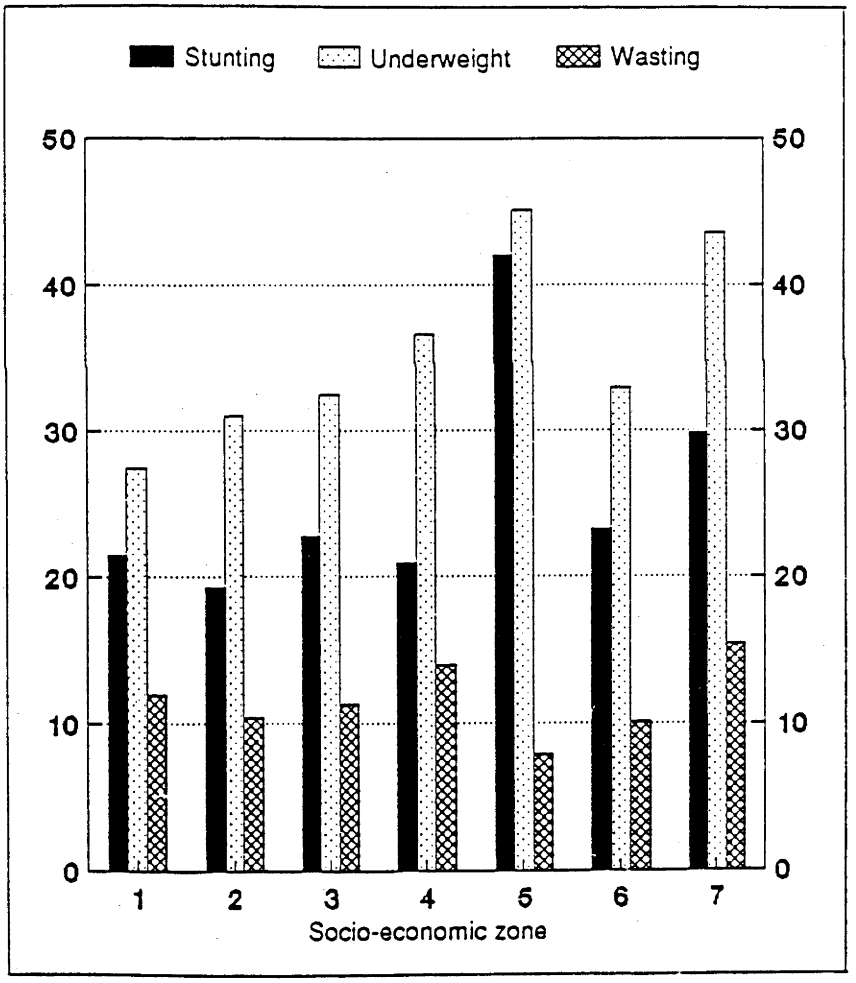


Figure 5.5 Prevalence of undernutrition in socio-economic zones by indicator of undernutrition.

Differentials in child undernutrition between the four residential areas became more clearly evident when age patterns of stunting and wasting in the residential areas are examined. For each age group as seen in Table 5.8, the prevalence of stunting is

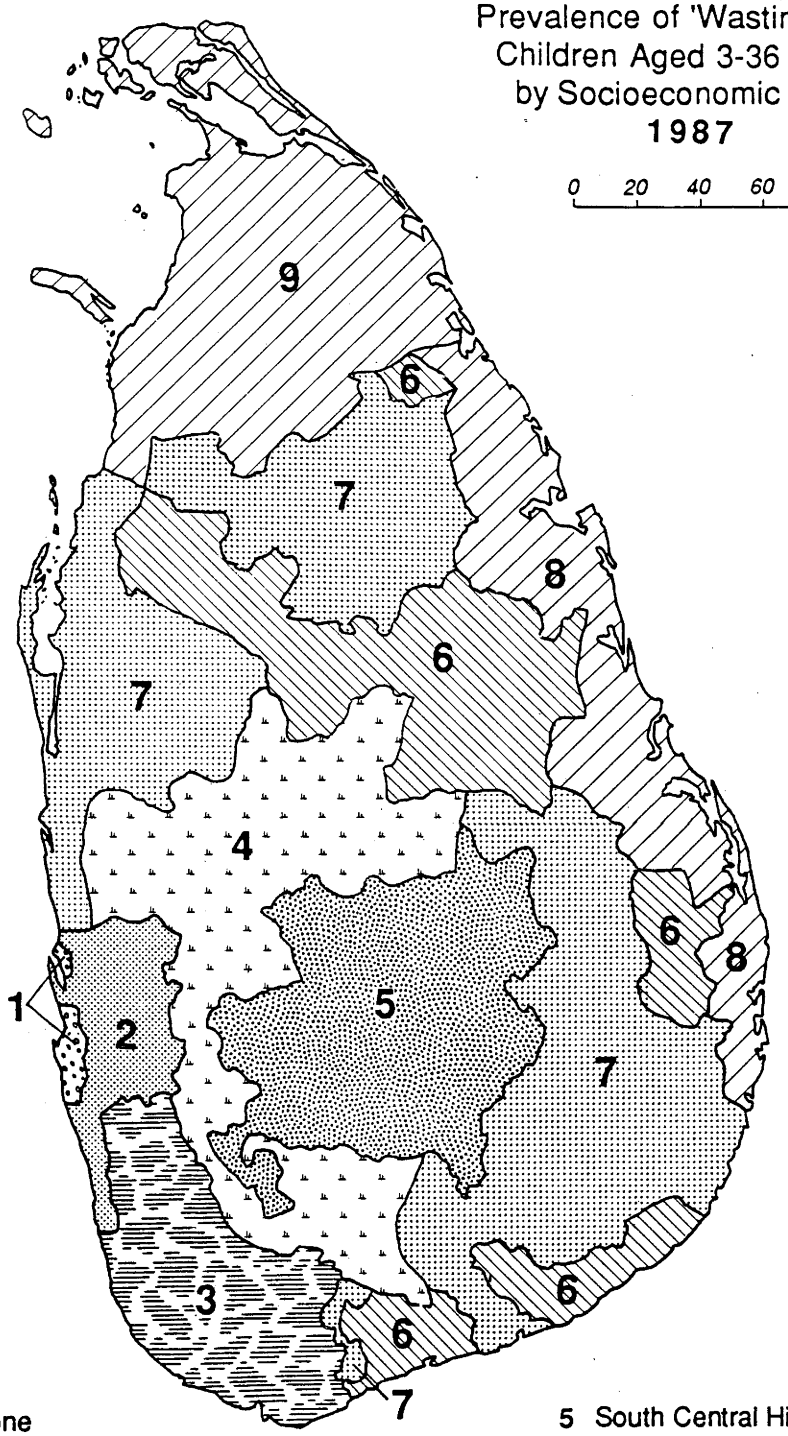
Map 4.2

SRI LANKA

Prevalence of 'Wasting' among Children Aged 3-36 months by Socioeconomic Zone

1987

0 20 40 60 80 km



- 11.9%
- 10.3%
- 11.3%
- 13.9%
- 7.9%
- 10.1%
- 15.4%
- not surveyed

(Excluding multiple births)

Zone

1 Colombo Metropolitan
2 Colombo Feeder Area
3 South Western Coastal Lowlands
4 Lower South Central Hill Country
5 South Central Hill Country
6 Dry Zone (irrigated)
7 Dry Zone (rainfed)
8 Eastern Coastal Belt
9 Northern Province

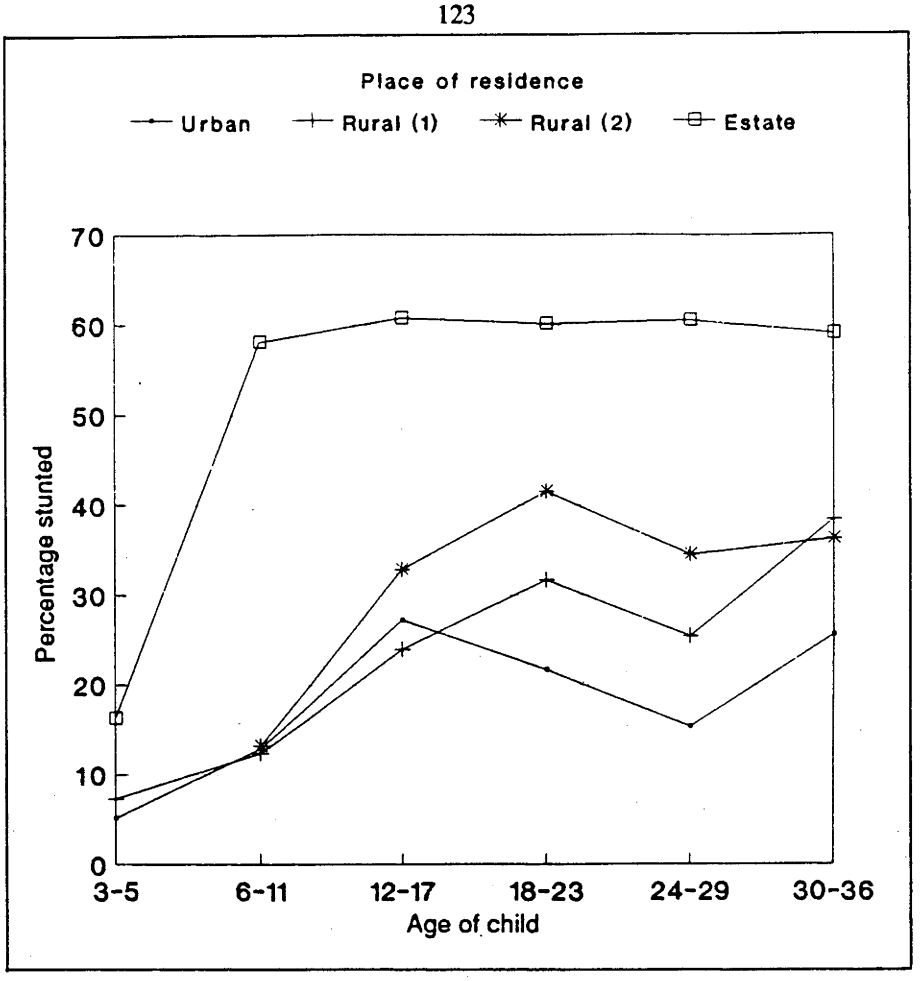


Figure 5.6 Percentage of children stunted (low length for age) by age and residential area.

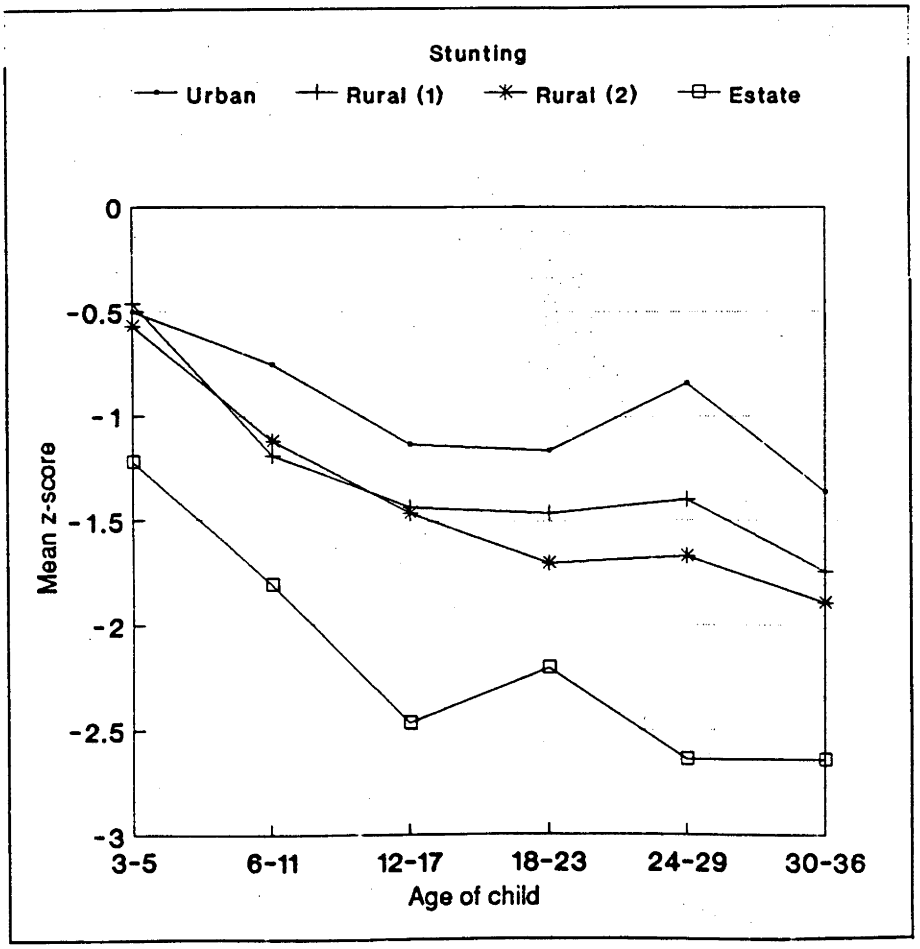


Figure 5.7 Mean z-score for stunting by age and residential area.

Table 5.7 Percentage of children undernourished, mean z-scores (by comparison with WHO-NCHS reference), and number of children aged 3-36 months by type of indicator of nutrition, age and residential area

Indicator/ residence	All	Age group of child (months) 3-5	6-11	12-17	18-23	24-29	30-36
			Per cent undernourished				
Length for age							
Urban	19.1	5.2	12.9	27.2	21.7	15.4	25.6
Rural (1)	25.0	7.3	12.4	23.9	31.7	25.4	38.4
Rural (2)	30.0	-	13.2	32.8	41.5	34.5	36.2
Estate	59.9	16.3*	58.1	60.7	60.1	60.5	59.0
Weight for length							
Urban	10.3	5.9	5.4	9.7	16.8	12.8	9.2
Rural (1)	11.5	0.9	3.2	22.6	18.5	8.7	8.8
Rural (2)	15.9	-	1.9	19.4	26.4	20.0	14.9
Estate	4.9	-	-	6.6	14.8	1.8	3.5
			mean z-scores				
Length for age							
Urban	-0.96	-0.50	-0.75	-1.13	-1.16	-0.84	-1.36
Rural (1)	-1.33	-0.46	-1.19	-1.43	-1.46	-1.40	-1.74
Rural (2)	-1.47	-0.57	-1.12	-1.46	-1.70	-1.67	-1.89
Estate	-2.24	-1.22*	-1.81	-2.47	-2.20	-2.64	-2.64
Weight for length							
Urban	-0.87	-0.20	-0.74	-0.93	-1.12	-0.95	-1.05
Rural (1)	-0.98	-0.22	-0.65	-1.29	-1.24	-1.10	-1.13
Rural (2)	-1.13	-0.41	-0.77	-1.32	-1.42	-1.23	-1.17
Estate	-0.89	-0.15*	-0.58	-1.09	-1.04	-1.05	-1.11
			Number of children				
Urban	262	23	60	45	38	57	40
Rural(1)	1320	155	224	255	231	221	233
Rural (2)	254	21	46	53	52	51	32
Estate	130	13	22	23	24	24	23

* based on less than 20 observations.

conspicuously higher for estate children than for those in the other three residential areas (see Figure 5.6). In the estates, stunting increases rapidly from about 16 per cent at 3-5 months to 58 per cent in the second half of infancy and stays around 60 per cent through the rest of the ages (Figure 5.6). Mean z-scores also follow the same pattern, declining from -1.22 to -1.81 from 3-5 months to the 6-11 months and reaching very rapidly a value far below -2.00 which is the cut-off used to separate the undernourished

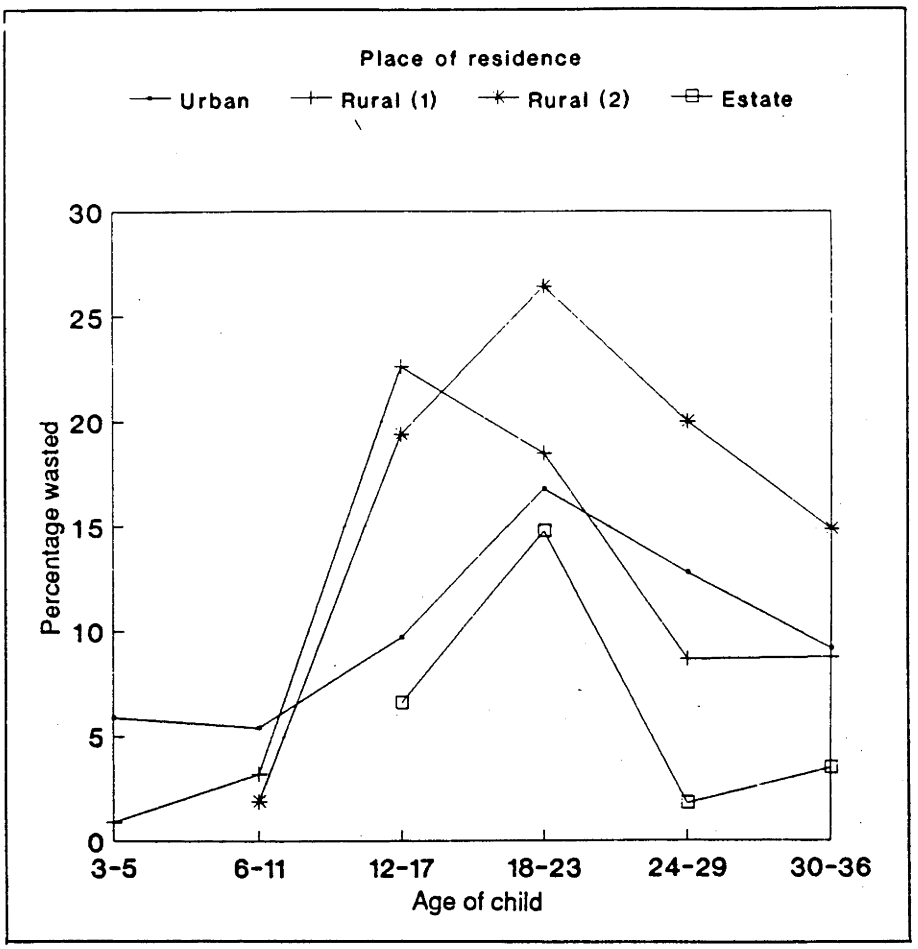


Figure 5.8 Percentage of children wasted (low weight for length) by age and residential area.

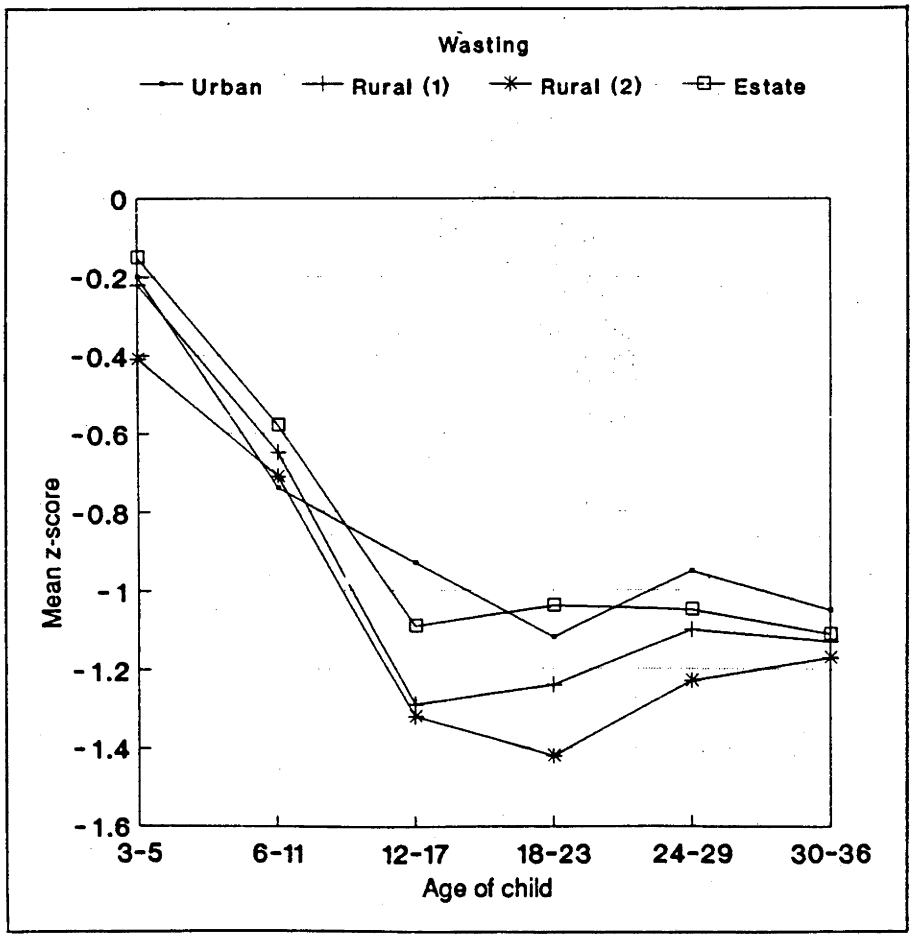


Figure 5.9 Mean z-score for wasting by age and residential area.

from the wellnourished. The other three residential areas generally show an increasing prevalence of stunting with advancing age, except in the age group 24-29 months, which is, as described earlier, largely an artifact. The increasing prevalence with advancing age of the child is, however, less marked among these children than those of the estate area.

The differentials in the prevalence of stunting between the urban and two rural areas are mainly seen among the children after the age of 12 months (Table 5.8), which implies that stunting is caused by the variations in breastfeeding and weaning practices between the residential areas.

The lower prevalence of wasting among children in estate areas than in the other three areas is clearly evident in all age groups (Figure 5.7). The peak prevalence in wasting is recorded among children aged 18-23 months for all residential groups except those in rural (1) areas where the peak prevalence begins slightly earlier (Figures 5.8 and Table 5.8). Comparison of the prevalence of wasting among children in the age group of peak prevalence (18-23 months), which is more meaningful in assessing differentials in the prevalence of wasting, shows that children in rural (2) areas are highly vulnerable to wasting, followed by those in rural (1) areas (Figures 5.8 and 5.9).

Waterlow and Rutishauser (1974) proposed a system of classification of nutritional status of an individual child or community by cross-classifying the length for age and weight for length, using a cut-off point that separates the under-nourished from the malnourished.[4] In its simplest form this classification, known as the *Waterlow classification*, allows the assessment of nutritional status of an individual or a group into four groups: children who are concurrently stunted and wasted, who are below the cut-off point by both indicators; stunted and not wasted; that is low length for age but an adequate weight for length (most of the so-called nutritional dwarfs fall into this

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4 Waterlow and Rutishauser (1974) used 90 per cent of the median from the Harvard reference population as the cut-off for wasting and 80 per cent of the reference median as stunting. In fact, Harvard reference did not have z-score values and permitted the use of percentiles and medians only. Later, when z-score values were available from the NCHS growth reference, the use of -2.00 SD units as the cut-off point was proposed for both indicators (Waterlow, 1985a:63).

category (Waterlow, 1978): wasted and not stunted: that is inadequate weight for length but satisfactory length for age; and the residual category, normal or healthy. Figure 5.10 displays the nutritional status of the study population according to the Waterlow classification.

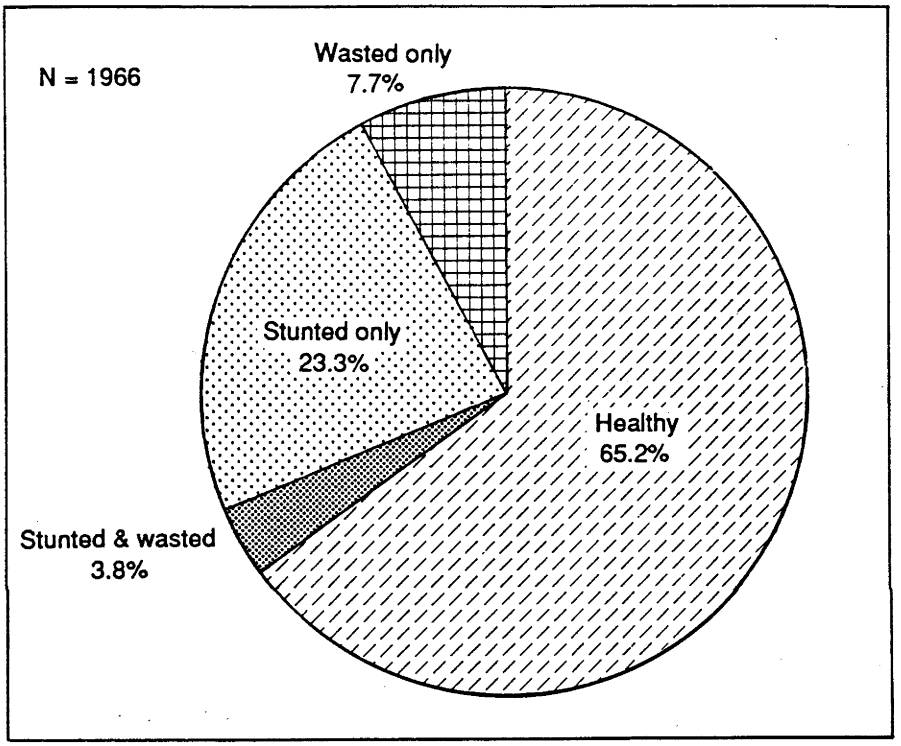

Figure 5.10 Status of child nutrition among the study population according to Waterlow classification.

For the population as a whole, about 3.8 per cent of the children (aged 3-36 months) are concurrently stunted and wasted, their z-scores being below -2.00 SD units for both length for age and weight for length. These children, who exhibit the effects of both past undernutrition and current or more recent undernutrition, according to Waterlow and Rutishauser (1974) should receive high priority in policy interventions. The proportion of children wasted but without showing any retardation of linear growth stunting is about 8 per cent of the total. They exhibit current or recent undernutrition but do not show a past history of undernutrition, and also require policy attention. A substantial proportion of children (23.3 per cent), are stunted but not wasted (have an

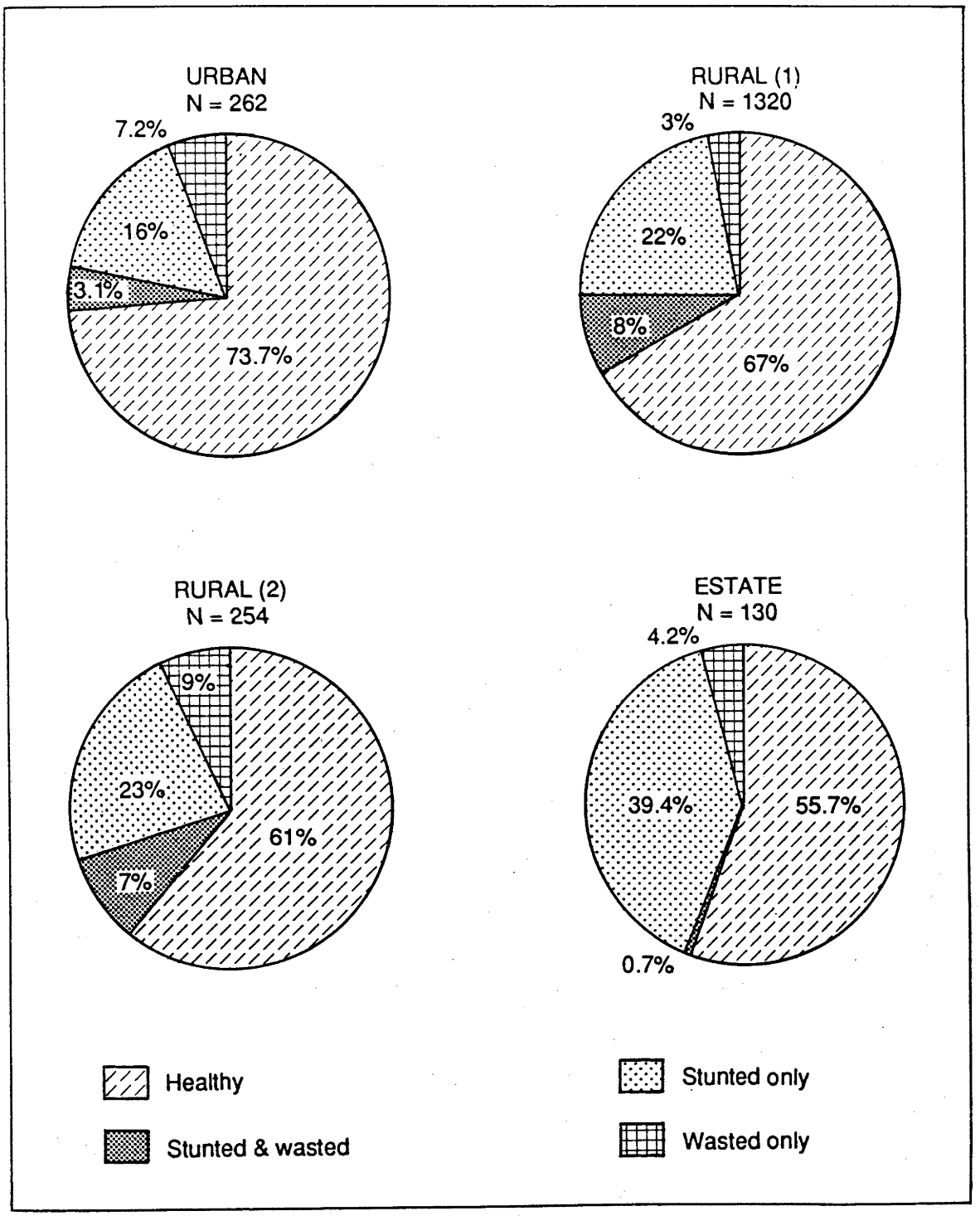

Figure 5.11 Status of child nutrition among the study population in residential areas according to Waterlow classification.

adequate weight for their length). Waterlow and Rutishauser (1974:14) state that:

> The child who is stunted should be regarded in a certain sense as malnourished here and now, as well as in the past, even though he may have a normal weight for his height.

This group includes severe cases of stunted children (nutritional dwarfs), children who have recently recovered from undernutrition, and others with mild to moderate degrees of undernutrition.

The pattern of variation in nutritional status of children examined according to the Waterlow classification between the four residential areas are depicted in diagrams presented in Figure 5.11. The proportion of children who are severely undernourished (stunted and wasted) is higher among the rural (2) areas, more than twice that in urban and rural (1) areas. The proportion of children stunted but not wasted is extremely high in the estate sector (56 per cent), followed by the two rural areas which each show almost similar levels (Figure 5.8). The urban children show the lowest (16 per cent). By contrast, prevalence of wasting without stunting is rare (0.7 per cent) among the estate children, higher in the two rural areas (about 9 per cent in each), and substantial (7 per cent) among the urban children. Thus in terms of nutrition the estate sector stands out as unique in that it has a very high prevalence of stunting without a noticeable level of wasting.

In general when chronic undernutrition is moderate the wasting tends to be low, and when chronic undernutrition is high wasting also tends to be high. As hypothesized by Martorell (1985:20):

> When children are faced with chronic but moderate deficiencies of nutrients, they will grow less in height and weight, but will manage to maintain normal proportions of weight to height. As the severity and duration of the nutritional deficiencies increase, children will cease to grow altogether and the process of body wasting will begin.

The pattern of nutritional status of children for the study population as a whole, as well as the pattern of nutritional status among children in the urban and two rural areas, is broadly in agreement with this hypothesis. But the estate sector behaves differently; in the estates the level of stunting is very high but the level of wasting is

negligible. Thus the pattern observed in the estate sector seems exceptional compared to the other population groups, and has not been fully explained.

One explanation for the high level of stunting and low level of wasting comes from experimental studies on rats. Waterlow (1978) reports findings of a few such studies (one of his own) where pups born to marginally underfed rats for some time had retarded growth but had normal body weight to the attained length. On the basis of these results Waterlow hypothesizes that stunting is an outcome of malnutrition *in utero* or in the early neonatal period. Undernourished mothers in general give birth to low birthweight babies, have a smaller volume of breastmilk and short duration of breast-feeding. Thus the stunting is a result of undernutrition at the time when the growth is more sensitive to adverse conditions (Waterlow, 1978:458). Since the recovery from stunting, if it is reversible at all, is a very slow process, it continues to prevail in the first few years after birth. Thus the evolution of stunting is a process from pregnancy, while wasting is a result of current or recent health problems due to inadequate food intake or infections or a combination of both. In these circumstances a high prevalence of both stunting and wasting may not go together.

The gains and losses in weight usually take place very rapidly. The gains in height or length are relatively slow and marked retardation is `likely to be more permanent than retardation in weight' (Seoane and Latham, 1971:98). Short stature among estate children thus could be a long-term effect where recovery is not possible or very slow, and the low wasting signifies their health is less affected by recent food intake or infections.

Differentials in the prevalence of stunting between the socio-economic groups in general and residential areas in particular, could be a reflection of different patterns of dietary intake; it is possible that children of communities with low protein intakes are more likely to be stunted than those in communities where protein intakes are high. For instance, according to study by Smith (1991) of dietary intakes of the household and the nutritional status of children in Papua New Guinea, stunting among children was high

in communities with a low protein and low fat intake (determined from the food consumed during 24 hour-period), mostly from the Highlands. Similarly it was found that the prevalence of stunting was low among communities with high protein and high fat intakes. On the basis of these results the high prevalence of stunting in some communities was largely attributable to diets low in protein and fat.

No data are available from the SLDHS to examine this relationship between the food consumption and growth patterns of children, but the dietary data gathered from socio-economic surveys have consistently shown that for each income group per capita daily calorie and protein consumption was higher among the estate population than the other two residential areas (see Tables A.5.4, and A.5.5 Appendix). Yet this sector has the highest prevalence of stunted children. The lowest calorie consumption was found among the urban households. The bulk of calories in the diet come from rice and coconut, the major food items common to all sectors of the country. The higher calorie intake among the estate population is attributed (Shan, 1984) to the high calorie demand arising from greater physical activity associated with daily work, higher altitudes and cold climate. The proportion of food expenditure to the total household expenditure is also high in the estate sector (Shan, 1987). The lowest calorie intake in the urban sector is partly due to the low food share and the greater variety in the consumption of goods such as meat and fish, which is common among the urban households (Shan, 1987:319). These food items have a high rupee value per unit of calories consumed. The data at the community level available for Sri Lanka, thus do not support the hypothesis of negative association between protein intake of the community and stunting among children. However, more research is necessary in order to understand fully, the nature of the relationship between calorie and nutrient intakes and their relationship with the nutritional anthropometry of children.

A commonly held view in Sri Lanka is that the high level of stunting among the estate children is a result of genetic influence rather than a public health problem facing this community. There is also evidence that contemporary South Indian children also show a high level of stunting. In a study conducted in Tamil Nadu State it was revealed

that 51 per cent of children (1-5 years of age) are stunted while 21 per cent were wasted. On the basis of these results Steinhoff and others (1986:462) raise `the possibility that genetics may have contributed to the high rate of stunting'. They also acknowledge the findings in India and neighbouring countries of Nepal and Sri Lanka where the well-to-do children in these countries are anthropometrically similar to the NCHS reference population and are both heavier and taller than less advantaged children.

According to the results of a recent study carried out by the National Nutrition Monitoring Bureau of India of pre-school age children in ten states (results not shown by state level), over 50 per cent were stunted and about 6 per cent wasted (Sastri, Vijayarsghavan and Rao, 1989). They concluded that India's nutrition problem is mainly the low height for age, a long-term condition, and attributed it to poor environment, faulty feeding habits and widespread infections. More importantly, Sastri and others found the the prevalence of stunting among the population has declined from the levels recorded in 1974. As discussed earlier in Chapter 3, when socio-economic differentiations in a society are wide then the linear growth of children mainly demonstrates the environmental rather than genetic influences.

The population living in the estate sector is considered one of the most deprived population groups in the country; it consists largely of the descendants of Indian immigrants who were encouraged by the British to migrate from poverty-stricken and famine-prone parts of South India to work in the estate plantations from the mid-nineteenth century (Jayawardena, 1984; also, Langford, 1982). They have been deprived in many respects; economically they were deprived for many decades as cheap labour for the planters and although, since the estate takeover by the government after 1972, there have been improvements in the wages of the estate labour population, it nevertheless still remains the lowest paid sector of the country. Moreover, more than half the workforce in the plantation sector is female and the female wage rate in Sri Lanka is in general lower than that of the males. Females are assigned the labouring task — mainly unskilled — of tea-plucking or rubber tapping and, considering the

male-dominated society, Jayawardena (1984:319) describes estate women as a socio-economically deprived group within a deprived population. The estate workers were, until recently, deprived of citizenship rights. They were deprived of education; they are deprived in terms of sanitation and housing. Being a `stateless' group without much political influence they were by-passed in much of the development planning at the national level.

Such characteristics, according to Gopalan (1988:265), mean that the attributes of the `"poverty syndrome" invariably coexist and tend mutually to reinforce their respective ill effects. Children and adults caught up in this situation cannot but be stunted.

The deprivation among the estate population is not a recent phenomenon; they have been deprived for generations. According to Neville Edirisinghe (1990, personal communication), one of the possible reasons for the observed high levels of `stunting' among the estate children may be due to these historical factors: being drawn from the poorest environments from their homeland and have been living as poor for generations may have caused them to have relatively short stature. The immigrant labour population lived in the estates and did not integrate with other communities. Edirisinghe suspects that there could be an enclave effect, although there are no data on adult anthropometry to test this. For these reasons there is a high degree of homogeneity among the estate population of Indian origin which causes the variance around the mean to be very low compared to the NCHS standard. Edirisinghe (1984) also suggests the examination of cultural and historical factors to get a better view of the nutritional problems in the estate sector, and the highlights the importance of more research to determine how far the prevailing conditions of work and hiring contribute to the observed level of stunting (Edirisinghe, 1984:26).

The apparent short stature of estate children and their appropriate weight for the attained length may be a reflection of adaptation to the poor environment. Seckler presents his hypothesis of `small but healthy':

> If nutrient constraints are encountered at a given rate of growth, the rate is slowed to bring nutrient demand into equilibrium with nutrient supply ... [thus] short term equilibrium is established and the ultimate size and shape of the adult may be molded to the environment (Seckler, 1982:129)

According to this hypothesis, children who are stunted but not wasted and do not show any impairments are `adapted' and are `small but healthy'; they are adapted to low food intake without any functional cost (Sukhatme and Margen, 1978). The short stature of people, especially children, in poor areas may be a reflection of adaptation to deprived environmental conditions.[5]

However, the term `adaptation' implies a successful or desirable situation or, as Waterlow (1985b) points out, a process which permits the organisms to undergo dietary change without adverse consequences; a good fit of organism to their environment. Martorell (1989) points out that small body size among adults in developing countries is largely a result of infections and poor diets. If small body sizes are accepted as a desirable attribute because they are `adapted', Martorell argues that one should also affirm that its causes are also desirable (Martorell, 1989). Adaptation can be of several types; for instance, Scrimshaw and Young (1989:21) divide it into two categories: biological or physiological, and social or behavioural. The first of these is determined mainly by genetic make-up and the second by the nature of the society and the status and the personality of the individual. Thus there is a great deal of variation in adaptation between individuals. Scrimshaw and Young (1989), after examining how an individual responds to low protein intake and low dietary energy, concluded that small body size is not a desirable state and response to low food intake is harmful to individuals and societies.

Stunted girls who will become short women are more likely to give birth to retarded babies with a high risk of death during infancy (Martorell, 1989). It has been

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5 According to Eveleth and Tanner, in developing countries where the gap between the well-to-do and the poor is wide, `children will receive numerous insults during growth yet they survive, but bodily adaptation for survival are made which may result in smaller body size. If a whole population receives similar insults, such as a diet low in calories or protein, a small mean adult size results. If environmental conditions improve, the size both of children and adults increases' (Eveleth and Tanner, 1976:241).

shown that adults with short stature, although they look healthy, have impaired work capacity and low earnings (Gopalan, 1983; 1988; Spurr, 1988); their morbidity (Tomkins, 1988) and mortality risks are high (Van Lerberghe, 1988); their learning capacity and the brain development are impaired. On these grounds the basic argument in favour of the `small but healthy' hypothesis, that `adaptation has no cost', has not received wide acceptance (Messer, 1986, 1989).

As in the estate sector, rural (2) areas also record a high prevalence of stunting. Among these children the prevalence of wasting is also high. As has been discussed in Chapter 4, in several respects such as education, health, housing and environment the population in rural (2) areas are also subject to deprivation and abject poverty. Most probably the observed differentials in stunting may be a result of the differentials in the feeding pattern. Some aspects of this are discussed in Chapter 6.

Summary

The nutritional status of the children, examined revealed that undernutrition in Sri Lanka is more a long-term phenomena, where a sizeable child population in the 3-36 months age range exhibits a low length for age. Although wasting is found to less common, nearly 12 per cent of the children are affected by it which is high by global standards. The most deprived groups identified on the basis of socio-economic characteristics, the estate and rural (2), show high prevalence of stunting. Poverty is a problem facing virtually every developing country and stunting is an important indicator of poverty (Van Lerberghe, 1988:280), thus it is not surprising to see a high level of prevalence among the poor groups. The estate children, who record a very high prevalence of stunting, show an appropriate weight for their short length. They demonstrate long-term undernutrition without much evidence of a recent undernutrition. By contrast children in rural (2) areas are not only stunted but prevalence of wasting is also high, indicating presence of both long-term and current nutritional deficiencies.

Chapter 6
Breastfeeding and Weaning

6.1 Introduction

It has been seen in Chapter 4 that the level of nutrition of most of the children among the study population begins to fall, in comparison with the reference population, in the first half of infancy and continues to fall throughout most of the toddler years. Such a pattern in general is an indication of inadequate food intake of infants and can be associated with occurrences of infections (Mata, 1978a). The quantity and quality of breastmilk depends largely on the maternal diet during pregnancy and lactation (Harfouche, 1970:144). Breastmilk is considered the most important and natural food available for the newborn. While providing all the necessary nutrients in appropriate balance, it also gives the stimulation and protection against infection which babies need at very early ages (Harfouch, 1970; Jelliffe and Jelliffe, 1978a; Mata, 1978b). Thus, it is vitally important for the study of child nutrition to understand the patterns of breast-feeding and the processes of weaning prevailing among the study population and to assess their variations by socio-economic groups. The knowledge of these patterns will be of use for the interpretation of the results of the study, and in assessing the influence of these behaviours on the nutritional status of children. Within certain methodological and data limitations this chapter attempts to undertake this task.

Weaning is a process which involves a systematic switch from one stage of feeding to a completely different form: from milk (breastmilk) to the family food. The word weaning is defined in different ways for different purposes. The word is derived from the Anglo-Saxon *wenian* which means `to [become] accustomed to something different' (Poskitt, 1987:36). Normally any food other than breastmilk (or approved formula milk) is considered a weaning food. However, because of the practice of giving various food items in negligible quantities, and not in significant amounts, some researchers define weaning food as `a systematic introduction of any food other than

breastmilk' (Martorell *et al.*, 1985). An assessment of such practices can best be made from prospective studies where the age of introduction, the amounts and the frequency of giving such foods can be more accurately recorded than in a retrospective survey, such as the SLDHS, where the accuracy of such data is severely affected by recall lapses. It has also been observed that mothers who introduce various food items in small quantities often do not report that they are giving these foods. Of mothers who initially reported not giving any food to the infant, Whitehead and Paul (1985) observed: `careful probing reveals that they give small amounts of other foods'.

For the purpose of this analysis, weaning is defined as the complete cessation of breastfeeding as in this case there cannot be any confusion over the process, hence the data are more accurate.

6.2 The Data

The DHS, core `A', questionnaire on which the SLDHS questionnaire was based, had several items on breastfeeding from which prevalence and duration of breastfeeding can be derived. The data were collected only for children born since January 1, 1982. These included questions on whether the child was ever breastfed and, if so, the duration of breastfeeding was recorded. What is meant by breastfeeding was, however, not defined and as a result it includes different feeding behaviours such as exclusive and mixed feeding. The current breastfeeding status was asked only for the last-born surviving child as it was assumed that nursing any older sibling would be stopped when the mother discovered that she was pregnant. The mothers who reported currently breastfeeding the last-born child were probed as to the following: number of times breastfed in the previous night and the times breastfed during daylight hours; whether plain water, fruit juice, powdered milk, cow's or goat's milk, liquid, solid or mushy food was given to the child during the previous day or night. Those who reported giving any of these foods or liquids were also asked whether anything was given to the baby in a bottle with a nipple (Q.449, Q.451, see Appendix A.6.1). In addition to these, the SLDHS included several additional questions relating to breastfeeding and food

supplementation which were collected for the children born since January, 1, 1982 (Appendix, A.6.1). Mothers were probed as to whether the child was ever given powdered milk (half cream, full cream), cow's milk, rice cunjee (rice-based porridge), eggs or fish, mashed potatoes or cereals, and fruit juices or soup, and if any of these foods were given, the age at introduction of the food was recorded (Q.415). Then they were asked about the age at which the child received any such foods on a daily basis (Q.416). Although the information available is not detailed enough to ascertain the patterns of food supplementation and weaning completely, and there may also be errors owing to reporting bias, the responses can still be useful in deriving the broad pattern of food supplementation and weaning according to children's socio-economic background, which had hitherto not been available from a nationally representative sample.

6.3 Importance of Breastfeeding

Breastfeeding is important for the health and development of babies: they need appropriate nutrition, affection, stimulation, and protection against infection. Breast-feeding meets all these needs and gives them the best start in life (WHO, 1979:3). Although in terms of the nutritional needs of the young child, modern formula milk is as good as human milk nutritionally when prepared under hygienic conditions, human milk occupies a unique position as it alone is rich in most properties protecting a newborn from diarrhoea, infections, and food allergies (Harfouche, 1970:145; Jelliffe and Jelliffe, 1979b:247, Labbok, 1985:45) and in these respects it is estimated that the protection provided by human milk has not been duplicated by any other means (Goldman, 1979:55). Much of the illness in infancy and childhood, particularly in developing countries, is attributed to diarrhoea and respiratory infections. Epidemiological evidence shows that breastmilk protects against respiratory and other enteric infections and this is a particularly important factor in ensuring the survival of children in developing countries with poor environments, where both incidence and duration of breastfeeding are high (Goldman, 1979:55). Compared to artificial milk, the danger of contamination due to dilution is virtually absent in human milk as it is

directly fed from `producer to the consumer' (Jelliffe and Jelliffe, 1978a ; WHO, 1982). Breast milk, colostrum[1] in particular, has anti-infective properties which are needed for a child when it moves from the passive immunity obtained *in utero* through the placenta, to the more active immunity to be gained by direct exposure to viruses and bacterial conditions, and by immunization.

Although the design and methodologies adopted in studies of breastfeeding and the controls used in the data analysis have been questioned (Saulis, 1984), studies conducted in many parts of the world have shown that in normal circumstances, where mother and baby are in good health, babies who are exclusively breastfed show more satisfactory growth than those who are bottlefed and they suffer relatively less from infections in very early infancy (Plank and Milanesi, 1973; Jayasuriya and Soysa, 1974; Mel, 1980; Cushing and Anderson, 1982).

Indirectly, the length of breastfeeding has an effect on the birth interval as well: when a woman does not menstruate while nursing, she does not ovulate; when she starts menstruating, she may have an anovulatory cycle. Prolonged breastfeeding suppresses ovulation. When the mother fully breastfeeds her baby, without supplementation, particularly in the first half of infancy she is less likely to become pregnant again (Mosley, Osteria and Huffman, 1977:94; WHO, 1979:11). Suckling at the breast stimulates the production of the hormone prolactin which suppresses ovulation, making conception less likely (Morley, 1973; Mosley, Osteria and Huffman, 1984). In developing countries, it was demonstrated that the median interval between births was longer when median breastfeeding duration was long, despite low prevalence of contraception, than that among mothers with short breast-feeding durations, indicating breastfeeding duration as a key factor in traditional birth spacing practices (Gray, 1981; Smith, 1985). The exact contraceptive effect of breast-feeding depends largely on the frequency, intensity and duration of suckling (Latham, 1982:2). Apart from the health

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1 Colostrum which is also known as the first milk `is a sticky yellowish fluid which fills the alveolar cells during the last trimester of pregnancy, and is secreted for some days after birth' (WHO, 1989:25).

from the health improvement of the mother associated with longer birth intervals, there is another effect on her health; when nursing in the early months after birth, women do not normally menstruate. This helps them to conserve their iron reserves at a time when their nutritional level should be maintained or increased. According to Berg breastfeeding is an important consideration in poor areas where anaemia is prevalent (Berg, 1973:97).

6.4 Prevalence of Breastfeeding

Among children 0-36 months old, about three quarters were reported breastfeeding at the time of the survey and therefore breastfeeding durations for the majority of the children are incomplete. Due to this problem, which is known as censoring, a life table approach is suitable for estimating durations and assessing the socio-economic variations of breastfeeding. Two factors are important in an analysis of the prevalence of breastfeeding: the first is the initiation and the second is the duration of breast-feeding.

In any society the women who are unable to initiate breastfeeding for physiological reasons form only a small minority, estimated at about 5 per cent by Deem and McGeorge (1958); it will not under any circumstances exceed 10 per cent of women (WHO, 1981:1; Kent, 1981). Some studies have demonstrated a lower supply of breastmilk among poorly nourished mothers. According to FAO/WHO, the daily nutritional requirement for lactation is estimated to be about 550 calories; this imposes a drain on the nutritional reserves of poorly nourished mothers. However, there is evidence that even poorly nourished mothers are in general capable of successful breastfeeding (Huffman, 1984). It should be stated that the quantity of breastmilk may be lower among undernourished mothers but the quality may be less affected by the maternal nutritional status.

Among the study population the proportion of children aged 0-36 months who ever received breastmilk is over 98 per cent. Not only is this proportion high, but it

Table 6.1 Per cent distribution of children aged 0-36 months who have ever been breastfed by selected socio-economic characteristics

Characteristic	Number of Children	Per cent ever breast-fed
All	2364	98.3
Place of current residence	ns	
Urban	314	97.8
Rural (1)	1571	98.4
Rural (2)	318	99.1
Estate	161	96.3
Level of education of mother	ns	
No schooling	220	98.2
Primary	677	97.6
Secondary	875	98.5
Higher	593	98.7
Place of confinement	ns	
Institution	2080	98.5
Home	284	97.1
Housing type	ns	
Type 1	940	98.4
Type 2	510	98.2
Type 3	278	98.9
Type 4	636	98.0

ns = not significant.

does not vary significantly between socio-economic groups (see Table 6.1 for selected socio-economic background characteristics).

The most often-stated response for not initiating breastfeeding is `no milk or insufficient milk'; this is the reason given for 57 per cent of children among the never breastfed. The second most frequent reason was the death of the child; this accounted for 38 per cent of the children not breastfed, implying very early neonatal deaths.

6.5 Breastfeeding: Levels

Table 6.2 presents summary data on durations of breastfeeding for the children born in the three years before the survey, derived from life tables (SPSSX subroutine programme of Survival) and for different socio-economic background types. In

general, where there is a higher prevalence of breastfeeding there is also a tendency for a longer duration of breastfeeding. However, there are some exceptions to this pattern in Jamaica and Brazil, where it was found that high incidences of breastfeeding were associated with short durations of breastfeeding (Huffman, 1984:171). The data from the SLDHS largely conform with the general pattern that `the higher the incidence the longer the duration'. As there are no significant socio-economic differences in the proportions initiating breastfeeding and for any socio-economic group the proportion breastfed was above 96 per cent, the association between the incidence and the duration across the socio-economic groups is not very important. The median duration of breast-feeding, estimated using a life table approach, yielded 22.2 months for children aged 0-36 months.

6.6 Breastfeeding: Differentials

6.6.1 Differentials by maternal fertility factors

Maternal fertility factors, in the present study, include age of mother at the time of birth of the child, and order of birth of the child. The sex of the child also was examined under this category although it is not strictly a maternal fertility factor. Maternal age and birth order are two characteristics which are interrelated; older women are likely to have higher order births than younger women. Those factors seem to exert an important influence on the patterns and durations of breastfeeding. For instance, Chen and others found in Bangladesh a positive association between maternal age and breastfeeding duration (Chen *et al.*, 1974). Similar evidence is available from other parts of the world: Graitcer and others (1984) in Haiti found that early weaning was more common among mothers under 25 years of age than older women irrespective of whether they were urban or rural dwellers (Graitcer *et al.*, 1984:11), while in all 18 countries where the WFS data on breastfeeding were examined, Ferry and Smith (1983) found, without exception, a tendency for higher durations of breastfeeding with increase in the age of women.

Table 6.2 Durations of breastfeeding among children aged 0-36 months classified according to selected background characteristic

Characteristic	N	Percentage breastfed for at least 3	6	9	12 (months)	Median duration
All	2354	90	84	79	68	22.0
(a) Maternal-fertility characteristics						
Sex of child						
Boy	1257	89	82	77	68	21.4
Girl	1097	92	86	81	79	22.3
Maternal age(years)						
Under 25	905	92	84	79	65	18.7
25-29	715	89	83	77	69	24.2
30-34	454	91	85	82	69	24.4
35-49	280	89	85	82	71	24.8
Birth order						
1	732	86	78	72	57	17.8
2	664	94	85	78	67	20.6
3	481	90	86	82	73	24.1
4	214	91	86	86	76	28.0
5 & +	262	94	92	89	82	30.7
(b) Socio-economic characteristics						
Place of current residence						
Urban	314	82	71	64	51	14.7
Rural (1)	1561	91	85	81	69	24.1
Rural (2)	317	97	94	91	80	24.4
Estate	161	88	78	71	60	18.5
Level of education of mother						
No schooling	188	93	89	89	82	35.0
Primary	605	92	86	84	78	24.8
Secondary	858	91	88	82	70	24.0
Higher	702	88	78	70	52	14.8
Work status of mother						
Not working	1728	92	87	84	78	25.0
Working in agriculture	468	89	78	68	44	12.7
Other work	158	80	69	62	50	13.0
Type of co-residence						
Living with parents	930	90	82	75	64	18.8
Not living with parents	1423	91	85	81	70	24.1

Table 6.2 (cont'd)

Characteristic	N	Percentage breastfed for at least 3	6	9	12 (months)	Median duration
(c) Environmental characteristics						
Housing type						
Type 1	935	88	78	70	55	18.0
Type 2	507	91	84	79	64	18.8
Type 3	276	94	89	87	82	30.0
Type 4	636	93	91	89	85	30.3
Source of drinking water						
Pipe	230	85	72	65	47	12.8
Public tap/tube-well	483	89	79	72	49	13.0
Protected well	854	90	85	81	75	24.9
Other	787	94	90	87	80	28.7
Toilet facilities						
Sanitary toilet	1037	88	79	71	56	16.8
Other toilet (excl. use)	724	93	88	86	80	30.0
Other toilet (shared use)	115	92	86	83	72	25.0
No toilet	478	93	88	85	90	24.0
(d) Health care behaviour						
Whether FHW visited during pregnancy						
Visited	1526	91	84	80	68	24.1
Not visited	828	91	83	78	68	20.0
Whether visited a clinic/doctor during pregnancy						
Visited	2257	91	84	79	68	21.8
Not visited	97	87	79	75	69	22.3
Place of confinement						
Hospital	2077	90	83	78	67	20.7
Home	277	94	90	89	76	24.4
Person assisting delivery						
Medical	2059	90	83	78	67	20.6
Trad. Birth Attendant	151	94	88	86	72	24.5
None/other	143	94	90	89	80	24.7
Time of initiation of breastfeeding						
Day of birth	1809	92	86	81	69	24.1
One day after birth	337	92	84	80	67	18.8
2 or more days after birth	208	72	68	66	57	18.2

In Sri Lanka, Ferry and Smith (1983:19) found that for the surviving children, the mean duration of breastfeeding increased from 17 months for mothers aged 15-24 to 25 months for the 35-49 group, although the association was not statistically significant. The relationship between the maternal age and breastfeeding identified in the WFS data are not found consistently in other studies. For instance, a WHO collaborative study did not find, except in Sweden, any effects of maternal age on breastfeeding duration even after controlling for parity (WHO, 1981:61).

The SLDHS data show that the median durations of breastfeeding are lowest (18.7 months) for very young mothers (maternal age under 25 years), while the median durations are about the same (at 24 months) for the rest of the age categories. The relatively longer durations of breastfeeding by the relatively old mothers (maternal age over 25 years) by comparison with the younger mothers may be a reflection of the general tendency to an early introduction of breastmilk substitutes by the latter group. A pairwise comparison[2] of the overall distributions of the breastfeeding durations between the age categories shows, however, that they are not statistically significant.

In traditional societies where deliberate efforts to reduce the family size are virtually non-existent, spacing between births is mainly achieved by the duration of breastfeeding because strong taboos on sex exist while breastfeeding. Accordingly, the achieved family size is a factor that determines the duration of breastfeeding (Jain and Bongaarts, 1981:86). The relationship between the order of birth of the child (used here instead of parity) and the duration of breastfeeding is positive: the median duration of breastfeeding progressively rises from 17.8 months for babies at first order births to 20.5 for second-order births, and reaches a level as high as 30.7 for higher-order births (of 5 or more). The shorter duration of breastfeeding among children of first birth order

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2 SPSSX subroutine programme on survival produces comparison tests between different pairs of categories using D statistic. `Statistic D is derived by comparing the survival time of each person in one subgroup with the survival time of all other persons in the other subgroups, and adding one to that person's score if it exceeds the other value or subtracting one if it is below it. This is repeated for all persons within the first subgroup to obtain a mean score. The process is then repeated for each person in the next subgroup, and for any additional subgroups. The value of D is then obtained from a formula which incorporates the mean scores of each group. This statistic can then indicate whether the differences between subgroups are statistically significant' (Young, 1987:16).

is because the mothers are likely to be younger and also more educated and more modernized than those of children of higher order births. If pregnancy is a strong reason for the cessation of nursing, it is possible that younger women are more likely to become pregnant again more quickly and easily than the older women, shortening their breastfeeding duration. It is also possible for them to switch over easily from breast milk to formula milk and in Sri Lanka the level of education, specially for females, has risen so that younger mothers `possess both the knowledge and the means, to do so' (Kent, 1981:22). The pairwise comparisons of the distributions of the breastfeeding durations showed that except for birth orders 1 and 3 and 2 and 4, the differences observed among all other categories are significant at $p < 0.001$ levels (see Appendix, Table A.6.2).

The sex of the child is a key explanatory variable in most breastfeeding studies specially in areas where son preference is greater. The data clearly show that during the first 12 months or so the proportion of children breastfeeding is slightly higher for girls than for boys; thereafter the differences become small and reverse after 24 months of age (Figure 6.1). This pattern suggests that the boys are likely to be weaned slightly earlier than girls, but if the breastfeeding lasts for more than a year, then both sexes have an almost equal chance of being weaned. If breastfeeding duration extends for more than two years, then boys are more likely to be breastfed than girls.

The observed differentials are significant only at $p < 0.05$ level. In general, such a pattern could be due to sex preference in favour of boys; sons are given family food earlier than daughters. There is also an alternative explanation for such differentials, which is perhaps more relevant in societies where evidence of deliberate discrimination against a sex is not strong:

> Infants with the smallest appetites may thrive on less than half the energy intake of those with the largest appetites. Infants with large appetites may deplete maternal nutrition more rapidly than do those with small appetites, so that their need for extra energy sources to maintain growth occurs earlier than average. Most studies of energy intakes show that at all ages boys have greater intakes than girls and more rapid rates of growth (Poskitt, 1987:51)

Thus boys receive supplementary food earlier than the girls because they need it earlier.

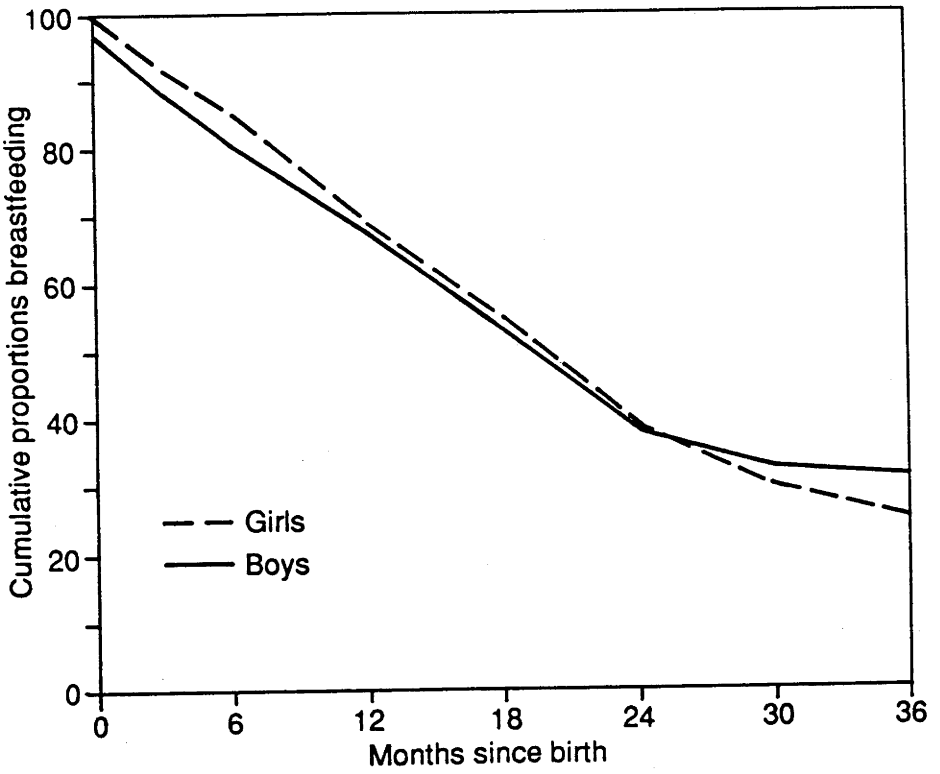

Figure 6.1. Proportion of children being breastfed at the beginning of age interval (in months) by sex of child.

6.6.2 Socio-economic characteristics

This section briefly discusses the relationship between breastfeeding duration and the variables of place of current residence, maternal education, work status of the mother, housing type, status of current residence, source of drinking water and toilet facilities available to the household.

As stated in Chapter 4, the place of current residence is examined according to four groups; urban; rural (1), all rural areas excluding Zone 7; rural (2) which consists of Zone 7, the less developed area of the dry zone; and estate areas. There are wide variations in the patterns and durations of breastfeeding between the residential categories. Urbanization, considered to be one of the factors responsible for the decline in breastfeeding in developed countries (Popkin and Bisgrove, 1988:19), has been increasing in Third World countries, reducing the prevalence and duration of breast-

feeding. Urbanization in Sri Lanka is low; less than a quarter of the population live in areas defined as urban (Department of Census and Statistics, 1986).

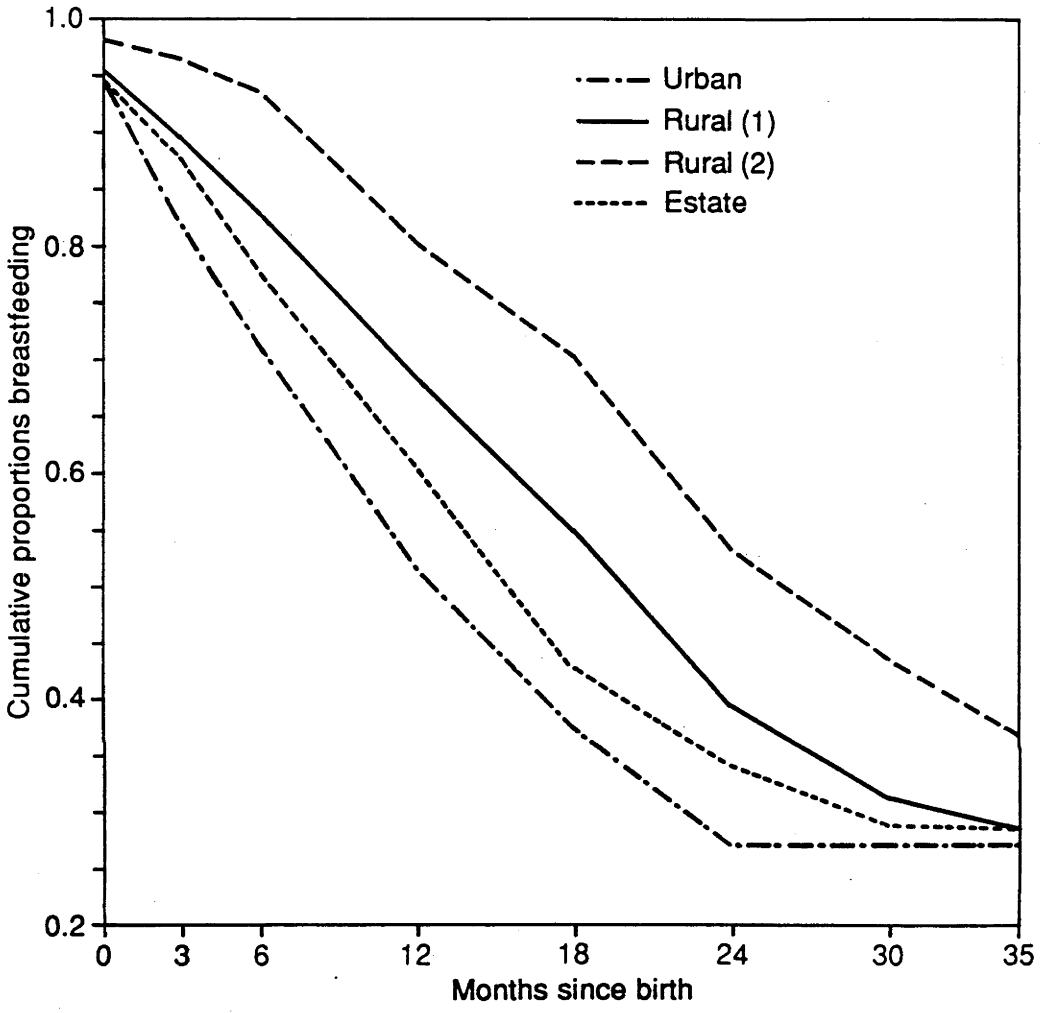

Figure 6.2. Proportion of children being breastfed at the beginning of age interval (in months) by place of current residence.

Despite the low level of urbanization shorter durations of breastfeeding are evident in urban areas than elsewhere. As shown in Table 6.2, 50 per cent of the children in urban areas were breastfed for about 15 months, which is nearly 10 months shorter than that estimated for rural children. The median duration of breastfeeding for estate children was about four months longer than that for urban, but was shorter than the two rural groups. A clearer picture of the pattern and differences in breastfeeding between the children in the four residential areas can be gained from Figure 6.2 which displays the cumulative proportions of children breastfeeding derived from the life table

survival function. By far the longest duration of breastfeeding among the residential categories is among the `rural (2)' children, those in the rainfed farming areas of the dry zone, the area least developed, least urbanized, and with a low level of educated population.

The median duration of breastfeeding progressively declines with increase in the level of education of the mother: children of mothers with no schooling receive breastmilk for a very long period (35 months) while the duration tends to decline by 10 months when the mother has a primary or secondary level of education. The median duration of breastfeeding does not differ between the latter two groups but their overall differentials are statistically significant (Table A.6.2, Appendix). The children of mothers with a higher level of education tend to be breastfed for a very short period: the median duration is about half those of mothers with no schooling.

The patterns observed are consistent with the previous findings from the SLWFS (Akin *et al.*, 1981; Kent, 1981; Ferry and Smith, 1983) and observations made in other societies (for instance, Avila *et al.*, 1980; Owie, 1980). Usually, educated women are more exposed to new ideas and more knowledgeable about the available breastmilk substitutes; they are also more likely to be in paid employment outside the home, thus their children tend to have early weaning. The tendency of declining breastfeeding durations among the educated is in contrast with what has been happening in the developed countries over the last two decades or so. Evidence is available from several Western countries that the proportion practising breastfeeding and the durations have been increasing; in the UK, Coals, Cotter and Valman, (1978) show that there has been an increasing trend in prevalence and duration of breastfeeding since the middle of the 1970s. Whitehead, Paul and Rowland, (1980) cite evidence that about 85 per cent of English babies leaving hospitals were being breastfed. The change initially began among upper class women who were educated and who responded to the promotional campaigns. Similar trends have been reported from the US by Hirschman and Hendershot (1979), and from Australia (Hitchcock, Gracey and Owels, 1981).

It is normally believed that women's behaviours in areas of feeding are influenced by other adult members in the family (WHO, 1981:102; Pelto, 1981), in particular the mother or the mother-in-law. A woman who starts her reproductive career at an early age, is more likely to depend on some adult who may be her mother, mother-in-law or even the traditional birth attendant as a source of information and emotional support (Ebrahim, 1976:196). It can be expected that breastfeeding duration will be longer in families where the mother is co-residing with her parents or in-laws who may themselves have breastfed their children for a long period; for instance, Butz, Habicht and DaVanzo, (1981) found in Malaysia, that mothers living in extended families had longer durations of breastfeeding. It has been suggested that the presence of others, mainly adults, will in many cases be an additional support for breastfeeding and this is particularly important when one considers the possible adverse effects of `anxiety, emotional tension and strain' on production of breastmilk (Popkin, 1978:467).

Contradictory evidence is also found in certain societies where women co-residing with their parents (or in-laws) have shorter breastfeeding durations. For instance, Popkin found in the Philippines that the presence of other adults led to early supplementation and termination of breastfeeding, mainly because the mother's time for child care is shared by the other members (Popkin 1978), and the WHO collaborative study found only one country, Guatemala, where mothers in extended families had markedly longer durations of breastfeeding (WHO, 1981:64). The exact influence of this characteristic may depend on other factors such as the education and the status of women in the household. When a mother is exercising greater control over household matters she is more likely to be educated, independent and modernized as well. The SLDHS data also do not lend support to the hypothesis that children are breastfed longer in households where women are co-residing with their parents or in-laws; children in households without co-residence show significantly longer durations of breastfeeding than the others ($p < 0.01$).

The relationship between the work pattern of the mother and the prevalence and duration of breastfeeding has been the subject of much discussion. The commonly held view is that female employment adversely affects the duration of breastfeeding (Jelliffe,

1979). Winikoff and Bear, (1980) have assembled the available evidence on women's employment and breastfeeding and found in a few studies a longer duration of breastfeeding among women in paid employment. This pattern may be due to the fact that women who are pressed for time find it easier to breastfeed rather than spend time to sterilize bottles, prepare formula milk and clean utensils. They also showed that when mothers were asked to give the main reason for the termination of breastfeeding, very few reported employment as the main reason. On the basis of this and other evidence some have concluded that it is not employment *per se* that is detrimental to breastfeeding but it is the employment outside the home which does not permit the mother physical contact with the infant (Van Esteric and Greiner, 1981: Solimano, 1987:104). However, as Butz *et al.*, (1981) pointed out, although work is not reported as the primary reason for the cessation of breastfeeding in survey inquiries, it is not advisable to reach any conclusions purely on these responses. In certain countries such as Sri Lanka, special leave facilities are provided after childbirth. There are also several laws and practices adopted in many parts of the world to encourage breastfeeding. One such statutory measure enforced for a long time in Sri Lanka is the maternity leave benefit which included a total of six weeks leave with full pay, two weeks before and four weeks after the confinement. In 1989 maternity leave for the women in the public service was raised to a total period of 84 days. In addition to this, nursing mothers were permitted, depending on the service requirements, half an hour to one hour each day, for breastfeeding during the first six months after birth (Senanayake, 1979).

The SLDHS data show that the children of mothers who report not working have a median duration of breastfeeding of 25 months, twice as long as those working in agriculture (12 months) and in other work mainly formal sector employment (13 months). The lower durations reported for agricultural occupations are due to the majority of estate workers in this category. In rural areas women can continue to nurse their babies while engaged in agricultural activities but this is not possible in the estates. The bulk of the female labour force in Sri Lanka is in the estate plantations, where the pattern of work necessitates the physical separation of the mother from the newborn.

This makes the breastfeeding durations shorter among children whose mothers are in estate agriculture. Because the estate workers have to work several miles away from the line rooms, it is also less practical to apply nursing break concessions to this population than in the organized modern sector.

6.6.3 Housing and environment

Breastfeeding durations are widely different between children according to the type of house in which they live. For each of the durations considered (Table 6.2) the proportion of children breastfed increases as housing type increases from better housing (type 1) to the worst housing (type 4). The median duration of breastfeeding rises from 18 months for a child living in a type 1 housing to 30 months in type 4 housing. The median durations however do not differ between types 1 and 2, and types 3 and 4 (graded according to ascending order in the socio-economic scale) but the overall distributions are significantly different between the different pairs of the housing categories (Appendix, Table A.6.2).

The relationship between the main source of drinking water of the household and the breastfeeding durations show that children in households receiving water from unprotected wells or ponds, streams and the like are likely to be breastfed for a longer duration than others. Their median duration of breastfeeding (29 months) is more than twice (13 months) those in houses with access to pipe water. These two extremes undoubtedly reflect the socio-economic status of the household; the former poor, and the households with access to pipe water connected to the housing unit (or to the premises) in general belong to the higher socio-economic group. The children in houses getting water from protected wells are mostly from rural backgrounds where typically breastfeeding durations are longer. However, the observed pattern is different. The children in the houses with access to water from public taps or tube wells demonstrate a relatively shorter duration of breastfeeding; as has been discussed earlier (Chapter 4: Table 4.2) the majority of them are in the estate sector. The others are mainly the low socio-economic groups in the urban sector.

Breastfeeding durations differ between children classified according to toilet facilities. As expected, children in households with a sanitary toilet, who are considered to be socio-economically high, had the shortest median duration of breast-feeding. As they are more likely to belong to low socio-economic households, the children in houses without any toilet were expected to have the longest durations of breastfeeding. The data show, however, the median duration of breastfeeding is longer among children coming from houses with unsanitary toilets (mainly pit type) and used exclusively by the household. The observed variations in breastfeeding durations are not statistically significant between the children in households differentiated by no toilet and other toilet exclusively used by the household.

6.6.4 Health care behaviour

As has been seen, the majority of births in the study population occurred in institutions, mainly government maternity homes and hospitals. It was also shown that mothers were visited by a FHW during pregnancy and relatively high proportions used antenatal clinic facilities. At the FHW visits and at the clinics pregnant women expected to receive, among other things, advice on breastfeeding. These antenatal visits are important as they provide an opportunity to prepare the mother for child care and feeding (WHO, 1981:64). The hospital environment and the attitudes and practices of the health care personnel during pregnancy, labour, and delivery all have an important influence on the decision to breastfeed and the durations (Winikoff and Baer, 1980: 105-106).

In this section, breastfeeding durations are examined according to whether the mothers were visited by a FHW or whether they visited clinics during pregnancy; their place of confinement: and the type of person assisting delivery. In terms of direction the durations observed for the first two characteristics are in conformity with the general expectation that those who used antenatal services gave breastmilk for longer durations than the others. The differentials observed are not statistically significant.

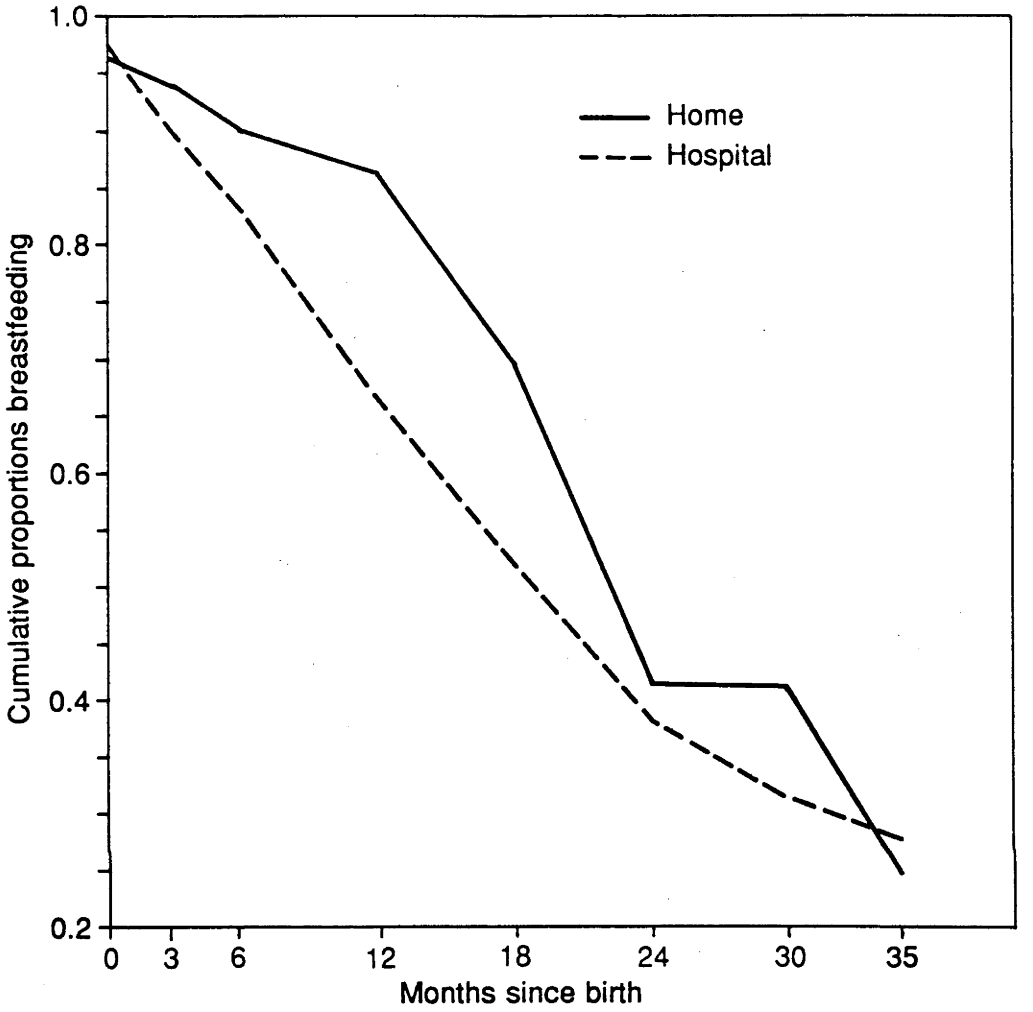

Figure 6.3. Proportion of children being breastfed at the beginning of age interval (in months) by place of confinement.

The differences observed in breastfeeding durations between the children born in hospital and at home are interesting. Paradoxically, at each duration the cumulative proportions of breastfeeding, without exception, are lower for those born in hospitals than those born at home (Figure. 6.3). In terms of median durations children born in hospitals have 21 months of breastfeeding compared to 24 months for those born outside hospitals. These differentials are statistically significant. Similar findings have been observed in many other countries; for instance the WHO collaborative study found lower durations of breastfeeding among those groups which used the health facilities most (WHO, 1981:64,69). In certain circumstances the lower prevalence or short duration of breastfeeding can occur as a result of hospital environment. The hospital

practices in various societies which discourage breastfeeding are summarized by McCann and others, (1981) as follows:

> ... discourage breastfeeding by separating the mother and infant immediately after birth, administering lactation supressants, offering unnecessary supplementary bottle feedings, establishing inflexible feeding schedules, and, during labor, performing episiotomies routinely, causing the mother pain which interferes with `let down' [reflex] and administering certain drugs ... which may impair a newborn infant's ability to suckle (McCann *et al.*, 1981:J 549).

In Sri Lanka the hospital routines, specially in government maternity wards, are in general in favour of encouraging breastfeeding. The attitudes of the different categories of health care personnel towards breastfeeding are encouragingly good, as reported in a recent study by Covington and others, (1985) which found that among the 36 health care personnel in maternity hospitals or wards in Sri Lanka interviewed as part of the cross national study, virtually everybody stated that they give mothers instructions regarding breastfeeding their newborns. These instructions included number of breastfeeding episodes per day, durations and hygiene, nipple care and the proper technique of feeding (Covington *et al.*, 1985:88). They also found that virtually everybody interviewed recognized the fact that breastfeeding should be the sole food for the newborn in the first three months and after that age breastfeeding should be continued with adequate supplementary food (Covington *et al.*, 1985:92, Table 10). Rooming-in procedures (newborn sleeps in the same room, and not necessarily in the same bed as the mother) are generally followed. However, overcrowding in maternity hospitals and wards causes an early discharge of mothers and babies (Soysa, 1981), making the follow-up action somewhat less practicable.

It should be emphasized that the observed relationship between breastfeeding and utilization of health care in general, and place of confinement in particular, is a reflection of the socio-economic background of the groups who are using such services, rather than a reflection of the effects of services provided or the attitudes and practice of the service providers. In order to find out which characteristics were most important in predicting the place of confinement, a logistic regression was fitted using place of birth

of the child (hospital born children and others) as the dependent variable. The results of the regression presented in Appendix A.6.3 show children more likely to be born in an institution are those living in relatively better houses (types 1 and 2), whose mothers had an educational level of secondary or higher, those living in an urban area or in a rural area except in rural (2) areas, and those whose mothers visited a doctor at least once when they were pregnant. These groups also had the lowest duration of breast-feeding. Thus it may be possible that a third factor, the socio-economic level, affects both behavioural patterns; duration of breastfeeding and place of birth. The same conclusion may explain the observed relationship between proportion breastfeeding and person assisting delivery.

6.7 Time of Initiation of Breastfeeding

For its survival, a newborn does not require any food in the first two to three days after birth but the initiation of breastfeeding soon after birth is an important factor encouraging mothers to breastfeed as an earlier time of initiation has been correlated with longer duration of breastfeeding (WHO, 1981:74: Saraliya, Easton and Cator, 19878. For the sample as whole, a majority (78.2 per cent) of children had been breastfed on the day of birth, and 15 per cent on the following day. About 7 per cent had received the first breastmilk feed three or more days after birth.

Although the exact reason for the delay in initiation of breastfeeding of these children is unknown and this group is numerically small, this aspect needs some attention. Part of the delay in initiation could be attributed to the cultural habits of not feeding colustrum (Van Esterik, 1988), while part may be due to certain complications of the birth process; for the sample as a whole, about a third of children did not receive colostrum because their mothers thought it bad for the baby. The highest proportion (70 per cent) of babies fed with colostrum were in the estate sector, followed by those in the urban sector.

Table 6.3 presents the data on the per cent distribution of children aged 0-36 months who were ever breastfed according to the time of initiation of breastfeeding and

whether colostrum was fed or not, by residential type. There is historical evidence to show a prevalence of a feeding practice among all ethnic groups in Sri Lanka which prevailed around the turn of the century, which explains to a certain extent the delays in the initiation of breastfeeding. As Meegama quotes from the report of the Colombo Medical Officer for the year 1911, in the first few days after birth babies are not given breastmilk or any other food but given castor oil and sugar, or cow ghee and sugar (Meegama, 1986:21). There is no information available to determine whether this custom is prevalent among the contemporary population of Sri Lanka but in a micro-level investigation it was revealed that it is still prevalent at least among the estate Tamils of Indian origin.[3] These practices in general, and giving castor oil in particular, may have deleterious effects on the health and survival of a newborn but giving honey or sugar is considered a traditional habit which encourages sucking (Ghosh, 1987:41).

Table 6.3 Time of initiation of breastfeeding, and the proportion of children given colostrum, by place of current residence

	Commenced after birth (days)			% fed	Colostrum
Type of residence	1	2	3	4 or+	(%)
All	78.2	14.5	3.8	3.4	63.1
Urban	81.8	11.1	4.7	2.5	65.5
Rural(1)	71.9	14.1	3.2	3.3	61.8
Rural (2)	71.9	16.7	18.8	6.1	60.3
Estate	72.9	20.6	5.3	1.2	70.3

* Differentials between the residential areas are statistically significant at the $p < 0.01$. of the χ^2 distribution.

Note: Percentages given in column 1 in all areas are higher than per cent fed colostrum reported in the last column of the table. The reason for the difference is that some mothers who breastfed on the day of birth of the child milk away the first few drops of milk before initiating breastfeeding thinking that are it is bad for the baby.

It has been found that weaning age is also influenced by the time of initiation and the observations are that mothers who initiated breastfeeding early were able successfully to establish breastfeeding and to carry on the practice for long durations.

3 Data gathered from an in-depth study covering different socio-economic groups in Sri Lanka which included population from a large estate in Nuwara Eliya district. (Unpublished information from a study carried out jointly by the Demographic Training and Research Institute and the Department of Demography, the Australian National Unversity.)

According to SLDHS results, the median duration of breastfeeding is highest (24 months) for the children breastfed since the day of birth, 18.9 months for those who began the day following birth, and almost similar among those who began to breastfeed later. The pairwise comparison of breastfeeding survival distributions however do not show that these differentials are statistically significant (Appendix A.6.2).

6.8 The Pattern of Food Supplementation

Although, breastfeeding is advocated as the sole food for the baby early in the life of the infant, additional energy and nutrition needs of the growing child have to be met by complementary food. There have been different opinions about the period in which breastmilk alone is adequate to meet the nutritional requirements; for instance Waterlow and Thomson (1979), after examining the available evidence of breastmilk supply and the requirements, concluded that in many developing countries breastmilk provides sufficient nutrients only for three months and thereafter additional food should be provided. Jelliffe and Jelliffe (1979a), however, were of the opinion that breastmilk is adequate to meet the nutritional requirements even up to 6 months. Studies by Whitehead *et al.* (1980) observed a falling-off in the supply and energy content of breastmilk after three months among rural Gambian mothers. They also found similar but slower declines even among the affluent mothers in Cambridge, England. Taking into consideration the evidence on breastmilk supply reported from different parts of the world, it has been stated that in a favourable environment where mothers are well nourished and the babies are in good health, breastmilk can be a sole food for infants in meeting the energy and nutrient requirements of the child 4-6 months of age (Waterlow, Ashworth and Griffith, 1980).

The most appropriate time to introduce complementary food depends on the individual child. In normal circumstances complementary food should be introduced to the infant's diet after four months of age to prevent the falling-off of growth (WHO, 1979). The need for additional energy depends on several factors, such as the growth and health of the child, the health and nutrition of the mother, the quantity and quality

of breastmilk, and the pattern (frequency and intensity) of breastfeeding and suckling (Latham, 1982). The appropriate time for introduction of other food, therefore, varies for each individual child. However, the age of the child is used as a general guideline for the introduction of other foods; the most appropriate age for the introduction of other foods to complement breastmilk is when the baby is 4-6 months old, unless otherwise indicated by the health of the child (WHO, 1989; Cameron and Hafvander, 1983; Committee on Nutrition, 1980).

More importantly, any additional food given before that age is not only unnecessary but can also be harmful and physiologically inappropriate (WHO, 1981:2). This is mainly because of the danger of exposing the newborn to infections such as gastro-enteritis which are common in unsanitary environments.[4] The introduction of other food, bottlefeeding in particular, is not desirable during this stage as it can interfere with breastfeeding; when a baby is exposed to bottle feeding it is likely that sucking at the breast and its frequency can be reduced as a result of decline in the `let-down reflex', affecting the supply of breastmilk. Sometimes a child accustomed to bottled milk will rarely accept the breast, so the newborn will not receive the immune benefits of breastmilk (Jelliffe, 1955; WHO, 1989).

Weaning is a process which involves a complete transition from breastmilk to family food (Winikoff, 1982). The beginning of the process is the initiation and establishment of lactation: every child should receive breastmilk at least during the first three months of life. Thereafter, depending on the child's requirements, additional food, mainly semi-solids, should be introduced. Studies have demonstrated that growth failures of infants, which occur in the third month or even earlier, are often found in developing countries as a result of infections associated with early supplementation, which is frequently contaminated (Mata *et al.*, 1977; Nabarro *et al.*, 1988). Because of the possible danger to the growth and health of children exposed to early

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4 Modern formula milk in their nutritional content is as good as breastmilk, three joint WHO-UNICEF recommendations were however to avoid formula milk feeding in the early months of life. When mothers are unable to breastfeed they suggest that feeding of the babies should be on human milk from other sources such as wet nurses or from human milk banks (WHO-UNICEF, 1979)

supplementation, some experts have even suggested not introducing any food supplements at early ages, even though as a result, infants may show mild marasmic conditions (Acta Pediatrica Scandinavica, 1977). Waterlow has shown that since in developing countries breastmilk supply is `usually' lower than those recorded for developed countries, the faltering of growth among children about three months of age may be mostly due to inadequate food intake (Waterlow, 1980c:212). For a four-month-old baby the daily average milk supply needed is estimated at 600 ml while protein requirements are estimated at 9 grams (WHO, 1971) which is considered higher than what an average mother in a developing country would produce. Although such estimated requirements of nutrients and energy have been questioned (Whitehead *et al.*, 1978), the evidence available on milk outputs shows that they are well below these requirements and from age three months onwards, a child does not receive the desired proteins and calories required from the breastmilk (Chavez *et al.*, 1975:93).

Whitehead and others found, in their comparative study of rural Gambian and affluent Cambridge mothers, that early supplementation was associated with a history of low breastmilk intake (Whitehead *et al.*, 1980:28), but they concluded that the rapid decline in milk consumption observed among Cambridge babies cannot be attributed to milk availability. There is evidence from certain European countries that the proportion of mothers who wanted to shift the baby's diet from breastmilk to formula milk because of `inadequate milk' had declined from 50 per cent to 8 per cent after psychological support by medical personnel (Ballabriga, 1987:146).

Complementary food should normally be introduced at 4-6 months of age in addition to breastfeeding (WHO, 1979). In general the introduction of supplements should not be delayed as even the optimum flow of breast milk cannot form the sole food of a growing infant after the age of six months, being inadequate in both calorie and protein (Jelliffe, 1955, 1978b) as well as other nutrients.

However, after 6 months or so, the process of weaning reaches another stage; during this time solids are gradually introduced and continue to be introduced until the child has completely moved to the family diet (Populatiion Reference Bureau, 1990).

The timing of the process of weaning described above can be varied according to the individual child but is strongly influenced by the socio-economic and cultural backgrounds. Such chracteristics undoubtedly have far reaching influences on child health in general, and in the growth and development of the child in particular. Thus a brief assessment of pattern of food supplementation and socio-economic variations is useful in the discussion of breastfeeding and weaning. The age at which any food was introduced on a regular basis has been used in this study to assess the pattern of food supplementation between socio-economic groups.

For normal children the introduction of complementary food at 4-6 months of age is encouraged in Sri Lanka, and introduction of any food before 4 months (medically approved or otherwise), or giving it later than six months, are both considered unsatisfactory practices.

Table 6.4 Per cent distribution of children aged 0-36 months who received other food on a regular basis according to age of introduction and by place of current residence.

Residence	N	Age (months) giving other food			
		All	<4	4-6	6+
			(Per cent distribution*)		
All	2354	89.1	65.4	27.6	7.0
Urban	314	92.4	77.9	17.5	8.6
Rural (1)	1562	89.7	63.8	29.0	7.2
Rural (2)	317	89.7	63.8	29.0	7.2
Estate	161	86.9	84.9	13.7	1.4

* Percentages are from the total number of children who received food on a regular basis

Table 6.4 gives the data on children who received food other than breastfeeding on a regular basis and the broad age group for which such food is given. The age

groups used are compatible with the practices recommended in Sri Lanka (Soysa, 1981), and also by the World Health Organization (WHO, 1989).

For children aged 0-36 months as a whole, about 89 per cent had received some food either in addition to or as a substitute for breastmilk. Of the total children who received other food on a regular basis nearly two thirds had received them before the age of four months — in normal circumstances an inappropriate period for supplementation. About a further 7 per cent had commenced receiving food other than breastmilk on a regular basis as late as six months of age.

There are important differences in the age patterns of introduction of other food between the residential areas: the majority (85 per cent) of estate children tend to receive other food on a regular basis even during the first three months, followed by urban children (78 per cent). This proportion is lowest (50 per cent) in the rural (2) areas. Of the children in this area (rural 2) about 11 per cent had not received such food on a regular basis even by the age of 6 months (Table 6.5).

For the entire study population only slightly more than a quarter had received other food on a regular basis in the appropriate period — during 4-6 months. This proportion is highest in rural (2) areas but still only 39 per cent of the total. The introduction of food other than breastmilk in the appropriate period is lowest among the estate children (14 per cent), followed by the urban (18 per cent). The data presented in Table 6.4 however do not take into account the relationship between breastfeeding status and the introduction of other food on a regular basis. The SLDHS questionnaire did include a country specific question (Q.453, Appendix A.6.1) which can be used to ascertain whether the breastfeeding continued, reduced or stopped when other foods were introduced on a regular basis.

Table 6.5 summarizes the information relating to the above question together with the age of introduction of other food on a regular basis. As has been seen in Table 6.4 for the sample as a whole, about two thirds (65.4 per cent) had received other food on a regular basis. Table 6.5 shows that 70 per cent had such food without reduction of

breastmilk or as a complementary food. About 20 per cent of the children experienced a reduction in breastmilk when these other foods were introduced, and in the case of the remaining 9 per cent breastfeeding was replaced with other food.

Table 6.5 Per cent distribution of children who were given other food on a regular basis, according to whether breastfeeding continued, reduced or stopped when such foods were introduced by age of introduction and place of current residence.

Age of introduction/ Place of residence	whether breastfeeding			
	Continued	Reduced	Stopped	N (weighted)
All children	71	20	9	2108
Given before 4 months:				
All	70	20	10	1378
Urban	60	22	18	226
Rural (1)	72	19	9	898
Rural (2)	81	14	5	130
Estate	66	28	6	124
Given during 4-6 months:				
All	74	19	7	581
Urban	67	21	12	51
Rural (1)	75	19	6	408
Rural (2)	78	17	5	102
Estate	51	35	14	20
Given after 6 months				
All	71	17	12	149
Urban	51	20	29	12
Rural (1)	71	19	10	103
Rural (2)	77	14	9	31
Estate	100	-	-	3

Similar patterns can be seen among the children who received other food on a regular basis (n=1378) before 4 months of age, but there are variations between the residential areas. Among them the proportion who continued breastfeeding without experiencing any reduction is low among the urban (60 per cent) and estate areas (66 per cent). Although the proportion of children given other food is the lowest (50 per cent) in the rural (2) area (Table 6.4), about four fifths of them did so while the breastmilk was continued without any curtailment. Reductions in breastfeeding is

somewhat higher (28 per cent) in estates than other areas, undoubtedly a reflection of the employment of the mothers. In urban areas too, similar patterns can be seen but the proportion who ceased breastfeeding is high (18 per cent). Among those who received other foods on a regular basis at the `appropriate time' (4-6 months) the majority (70 per cent) were supplementing while nearly a fifth were partially replacing breastmilk by reducing the breastmilk feeds (Table 6.5). Even among those who began receiving other food as late as after 6 months, a similar pattern can be found.

The number of children who received other food regularly after 6 months and continued to get breastmilk is less than those started earlier but still substantial; it ranged from 51 per cent in urban areas to 77 per cent in dry zone poor areas. In the case of urban areas the proportion that replaced breastmilk (29 per cent) is slightly higher than that of those who reduced breastmilk (20 per cent).

The pattern of reduction or complete withdrawal of breastmilk from the infant before the age of 4 months and also during 4-6 months is more marked in the urban and estate sectors. In the urban sector this may be a result of attitudes, urban lifestyles and the easy accessibility of breastmilk substitutes, and also of female employment. In the estate sector, however, except for the possible nutritional deficiencies of the mother about which no information is available, this is mainly a result of the work patterns of the mothers. The type of work in the estate plantations necessitates the physical separation of the mother from the child. Although mothers live on the estate, for day-to-day work they are required to be some distance away from the line rooms where they normally live. In large estates creches have been set up to look after babies of working mothers and at these centres the babies are fed with artificial milk.

Despite the very early introduction of other food, which is particularly undesirable in the context of the prevalent unsanitary conditions leading to infections, the pattern of introduction of other food on a regular basis while breastfeeding suggests that withdrawal of breastmilk is a gradual process. Irrespective of the time of introduction, abrupt cessation of breastfeeding occurred among only 10 per cent.

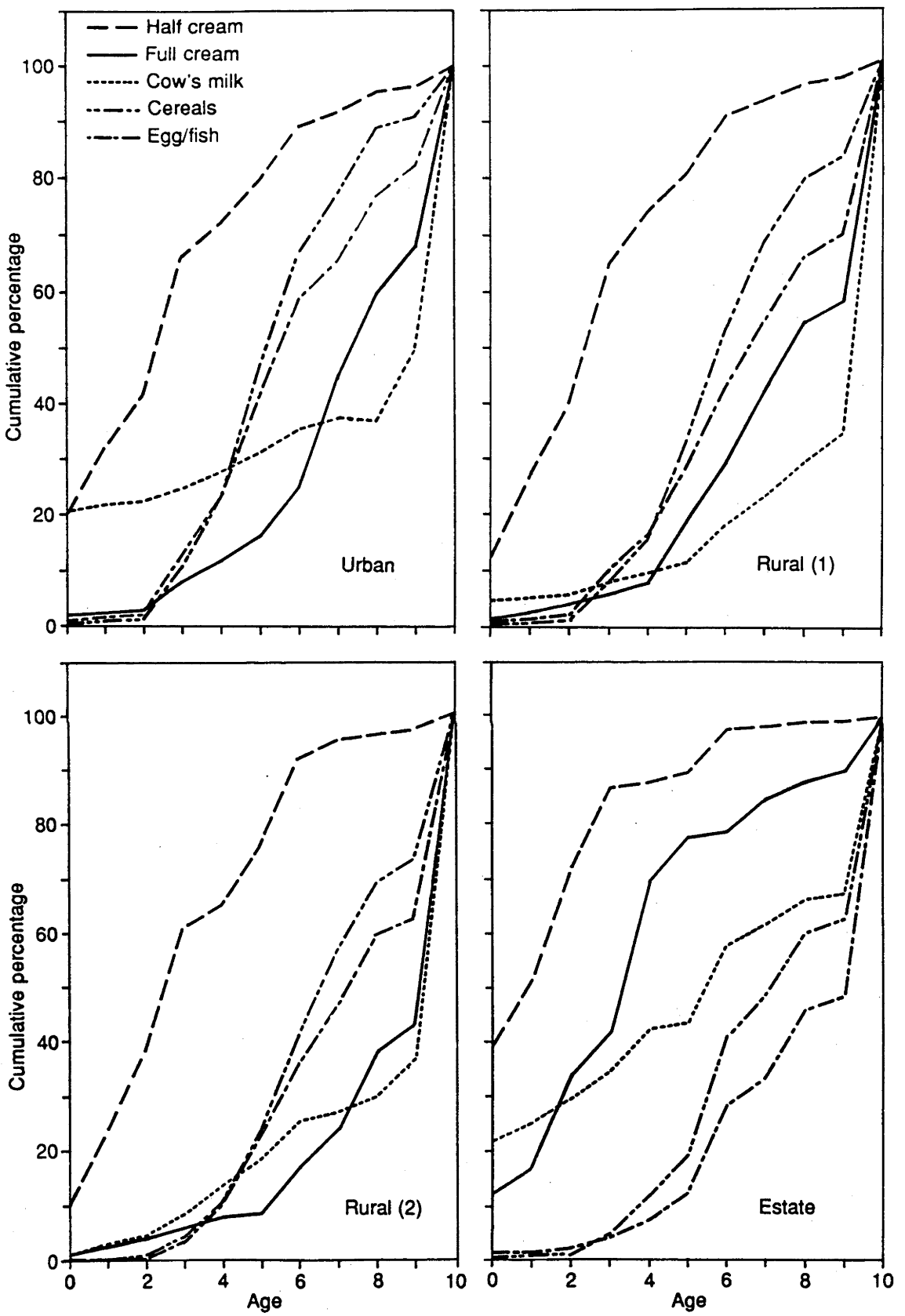

Figure 6.4 Pattern of initiation of food other than breastmilk by age of introduction and residential areas.

Gradual withdrawal from the breast is considered the most desirable method of weaning as it gives the child a chance to adapt to the local diet while still having the nutritional and anti-infective benefits of breastmilk as Martorell and others explain:

> Taking children off the breast suddenly can lead to severe malnutrition in the child ... perhaps as a result of interactions between biological factors (e.g. diet, infection) and psychological ones (e.g. anxiety, apathy) (Martorell *et al.*, 1985:24).

The total withdrawal of breastmilk at an early age also has the danger of exposing the newborn to infections, most commonly to diarrhoeal diseases. Sudden transfer from breastmilk to other food types can create problems of digestion as well.

6.9 Age of Introduction of Weaning Food

As stated above, the SLDHS asked for each child born since 1 January, 1982 whether specific food items (see Q.415, Appendix A.6.1) were introduced and if so, for each food ever given the age of introduction was recorded. Figure 6.4 shows the cumulative percentages of ages of introducing different food items for the four residential areas, as reported by the respondents. It should be noted that the reported timings of introduction of different food items may not be reliable as such data are normally subject to biases and problems of inaccuracies arising from recall lapses. Yet they could be used to identify broad patterns of introduction of supplementary foods between major socio-economic groups.

As shown in Figure 6.4 the introduction of formula milk (half cream) begins at a very early age among the estate children compared to those in the other residential areas: about 50 per cent of the estate children receive half cream by the second month and more than 90 per cent by six months. By contrast in the urban sector where one would normally expect introduction of formulas at an earlier age, 50 per cent of the children received it after the third month. The differentiation of formula milk according to half cream and full cream may not be accurately understood by the mothers but data show that they tend to introduce full cream mainly after the age of 7 months. This pattern is common to all areas except rural 2, where full cream usage is very low and

median age of introduction is as late as nine months.

There are several important variations in the introduction of solid foods: first, except for the estate children, those in the other sectors (disregarding the minor variations between them) receive solid foods early in life either in the form of cereals or mashed potatoes, or fish and eggs. Whatever the quantity or the frequency may be, they receive such foods even before they are introduced to full cream milk. In urban areas, a little over a quarter of children by the fifth month and nearly half by the sixth month receive solid foods. In the estate sector, by contrast, fish and eggs are introduced very late, later than the other solid foods; only 20 per cent receive any solid food by six months of age. Secondly, the estate children in general almost wholly depend on milk-based foods for the first six months or so. By the fourth month about a third of the estate children and by six months about two thirds receive formula milk with full cream. At these ages fewer than 10 per cent of estate children and 20 per cent of the children in urban areas receive full cream milk. Thirdly, cow's or goat's milk is the least popular children's food but its use is highest in the estate sector, which may reflect relative availability.[5]

6.10 Socio-economic Determinants of Weaning: Multivariate Analysis

6.10.1 Methodology

A conventional life table approach can be used effectively to discount the problems of censoring, but problems due to heaping remain in the data. The reported data on the duration of breastfeeding show that there is a clear pattern of heaping at various durations: first at three months and then later at multiples of six months. Such a pattern implies a classic example of digit preference or rounding off the durations to the nearest half year. It may also be the choice of breastfeeding duration conventionally accepted by the community. However, the pattern of heaping at digits, multiples of six months

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5 In recent years dairy farms were set-up on most of the estates by the Government with external assistance to improve the income and nutritional level of the estate population. The majority of the estate population are Hindus, who in general tend to consume more milk than other community groups.

or the depressions at durations adjacent to these, observed among those who have stopped breastfeeding, is not present in the currently breastfeeding population (Figure 6.5), implying that reported durations are not accurate.

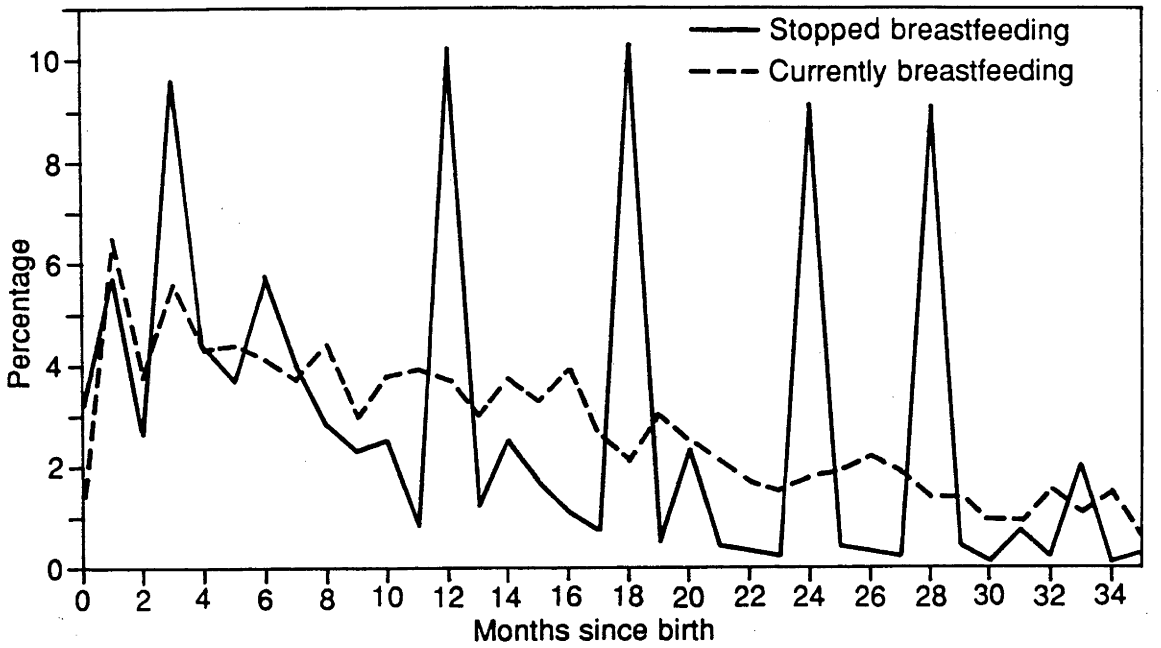

Figure 6.5. Distribution of reported breastfeeding durations and proportions of children being breastfed by months since birth.

Because of the possible contamination of data due to such biases, alternative procedures are used only in the information relating to the responses to a single question, `Are you currently breastfeeding?' to assess the breastfeeding pattern, so by-passing the duration data which are deficient (Page, Lesthaeghe and Adegbola, 1977). The advantage of such an approach is that it is largely free from the biases due to recall lapses and is less affected by any digit preference. These responses can then be linked to the age or the duration between the birth of the child to whom the question refers and the date of the survey. If the age reporting of children is satisfactory then this approach, which is known as the `current status approach', yields a reliable estimate on breastfeeding duration. Owing to the problems in the reported durations discussed earlier, instead of fitting the regressions using the traditional life table approach suggested by Cox (1972), this analysis makes use of the current status data to arrive at

an estimate similar to the proportional hazard models.

Procedures for this approach have been suggested by Diamond, McDonald and Shah (1986). Briefly, they show that when the relationship between a binary outcome derived from current status data and a set of explanatory variables is examined, the analysis can be done by linking the complementary log-log transformation of the probability of occurrence of the event in the time interval parameter and those for the explanatory variables. By exponentiating the resultant maximum likelihood estimates, it is possible to estimate the relative risks which are equivalent to those derived from Cox's proportional hazard model.

In the application of this model to the SLDHS data the dependent variable is whether a child of a specific age is weaned at the time of the survey. The event of interest is assessed from the point of view of the child and not the mother; thus for the purpose of the model those who were weaned (failure event) were assigned 1, and others 0. One of the requirements of the application of this procedure is that the proportion of children breastfed should be negatively associated with the length of time since birth (or age of the child). Because of the sampling fluctuations for some ages (mainly arising from small numbers), this pattern could not be found in the data. Therefore, to meet the criteria, the ages of children (length of time since birth) were grouped in the following five categories: 0-3, 4-11, 12-17, 18-30, and 31-36. In their application of the model to Pakistan data, Diamond and others (1986) have also shown that grouping of age intervals does not unduly affect the estimates derived from the model. This grouping also conforms with the concept that the ratio of hazard functions for the two individual groups are constant at a given age or age group, which is a basic assumption of the proportional hazard models.

6.10.2 Application of proportional hazards model

For the model examining the probability of a child aged 0-36 months old currently being weaned the analysis was restricted to the most recent birth and all multiple births were eliminated. Normally, breastfeeding of a baby is abruptly stopped when a woman

discovers that she is pregnant causing an interruption to the event, although there is some evidence, albeit rare, of women continuing breastfeeding even during pregnancy (Huffman *et al.*, 1980). The SLDHS questionnaire was drafted such that current breast-feeding status was not asked about the elder children, if any, and it was assumed they were not being breastfed. Children of currently pregnant mothers were also eliminated from the model.[6]

The results of the proportional hazard model are presented in Table 6.7. The coefficients derived from the proportional hazards model presented here refer to the net-effects of each variable relating to the `force of weaning' as opposed to duration of weaning, on the probability of a child being weaned at the specific age (Anderson, Rodriguez and Thome, 1984). Negative values of the coefficients in the model indicate that a child in that category is likely to be weaned later than the children in the baseline category. Similarly positive values indicate a high probability of weaning earlier than for children in the baseline category.

The individual relationships of the predictor variables with the outcome variable — whether a child at a specific duration since birth has been weaned or not — broadly correspond with the life table results discussed above, but the net effects of each of the variables are obviously different. Among the variables categorized under maternal fertility factors, only birth order is statistically significant. Sex of the child, which demonstrated a pattern of early weaning of boys, was found to exert a very weak association with durations of breastfeeding and is not a significant factor determining weaning. As shown at the bivariate level, the age of the mother at the time of the birth

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6 Restricting the population to the last surviving birth in the birth cohort of three years before the survey can cause selectivity bias as demonstrated by John, Menken, and Trussell (1982). Because of this a model was also fitted using all births including those of currently pregnant. This increased the child population by 491. The results of the hazard model relating to all births in the three year period before the survey are presented in Appendix A.6.4 for reference. The major difference found in the results of the two models was that instead of place of current residence which is significant at the earlier model, source of drinking water emerged as the most significant variable in this model. The main reason for the difference was that about 36 per cent of the additional children (491) included in the model with all births came from rural (1) households with access to public taps or tube wells and a further 11 per cent was estate area households with access to piped water (see Appendix A.6.5 and A.6.6). These two groups mainly have exerted a disproportionate influence on the model with all births.

is also not an influential factor. Probably, as Ferry and Smith (1981) speculated, the non-significance of this variable may be a result of its association with the interval between births which is `lactation induced' (Ferry and Smith, 1983:28).

Table 6.6 Parameters of the proportional hazard model fitted using last born surviving child aged 0-36 months to the current status data on weaning (currently breast feeding = 0, otherwise = 1)

Variable	Estimate	S.E	`t' values	Relative risk of weaning
Housing type	**χ^2=21.9**	**@ 3df**	**p < 0.001**	
Type 1	0			1.0
Type 2	-0.469	.133	-3.5	0.6
Type 3	-0.493	.163	-3.0	0.6
Type 4	-0.469	.123	-3.8	0.6
Place of residence	**χ^2=34.3**	**@ 3 df**	**p < 0.001**	
Urban	0			1.0
Rural (1)	-0.519	.121	-4.3	0.5
Rural (2)	-0.756	.179	-4.2	0.5
Estate	-0.190	.263	-0.7	0.8
Work status of mother	**χ^2=21.7**	**@ 3df**	**p < 0.01**	
Not working	0			1.0
Working in Agriculture	0.026	.244	0.1	1.0
Non agricultural work	0.541	.151	3.6	1.7
Birth Order	**χ^2=6.5**	**@ 2 df**	**P < 0.05**	
1	0			1.0
2-5	-0.188	.104	-1.8	0.8
6 or higher	-0.509	.224	-2.3	0.6

Total estimate: χ^2 1768.3 @ 1877 df.

S.E=standard error of the estimate

* Housing types: Type 1 = Tiled roof, brick walls and cement floor. Type 2 = tiled roof or brick walls and cement floor; Type 3 = tiled roof or brick walls and mud floor; Type 4 = Thatched roof, mud walls and mud floor.

Among the characteristics considered under environmental factors housing type emerges as the most statistically significant variable. The source of drinking water, which was very significant ($p < 0.001$) alone, is no longer significant when both the housing type and the place of current residence are included in the model (Table 6.6). Similarly, being correlated with housing type, the influence of toilet facility becomes statistically insignificant when the influence of the former is present in the model.

Among the socio-economic variables urban, rural and estate (four category variable) residence stands out as the variable influencing weaning most significantly followed by work status of the mother. The influence that maternal education exerts on weaning becomes less significant when housing type is present in the model, and disappears when place of current residence is also added into the model. This is because housing type broadly incorporates the education of the mother while to a certain extent the residential areas also represent educational level.

None of the variables considered under health care were found to be statistically significant, although each alone showed a statistically significant influence. As discussed earlier, this is a reflection of the selective nature of the population receiving health care who are mainly those in the urban areas, living in better houses and with better educational levels; children with these backgrounds are less likely to receive breastmilk for long durations.

The model also considered the influence of different interactions between the variables on the outcome variable and found that the influence of the interactions of residential type and source of drinking water is statistically significant. However, the individual categories of many of the various combinations of two variables resulted in a very small number of cases or zero cells . One way of handling the problem of small cell sizes would be to combine some categories, for example residential area or the water supply source, but it was not attempted owing to the obvious loss of information. Therefore only the interactions with large cell sizes were considered and no significant interactions were found.

On the whole, the hazard model results suggest that the probability of a child being weaned at a specific age is mostly governed by socio-economic and environmental factors. Assessing the relationship of income related variables with the duration of breastfeeding in Sri Lanka, using WFS data for the analysis, Akin and associates (1981) speculated that high socio-economic groups generally consider `breastfeeding as inferior good and when families become richer, they add breastmilk

substitutes' (Akin *et al.*, 1981: 296).

The variable housing type, as described in Chapter 4, is a composite variable created by considering materials used for the construction of the walls, roof and floor and a proxy for the socio-economic and environmental conditions of the population. Category 1 and Category 4 of this variable represent, respectively, the households at the top and the bottom of the socio-economic ladder; the latter, by any standard, manifests households in abject poverty. The remaining two housing categories occupy an intermediate position. For the purpose of grading them, the type of floor was used as the criterion and houses with a mud floor were considered inferior to those with cement floors. This categorization, although arbitrary, has been able to capture the households from high and low socio-economic strata.

Life table values, at the bivariate level discussed earlier, showed wide differentials between the four housing types (Table 6.2). When the presence of all other influences, particularly of the residential type, are taken into account, these differentials are confined to type 1 housing. For all other housing types (2, 3, and 4, the differentials in relative risk virtually disappears. Compared to the children belonging to the high socio-economic group (living in type 1 houses), those in the remaining three housing types (socio-economic categories) are likely to be weaned later; the relative risk of a child being weaned at a specific age will be 40 per cent lower among the latter groups than among those living in housing type 1. This is not unusual given the fact that change in any society switching from traditional to modern practices normally comes from the upper socio-economic groups. They possess the knowledge, the opportunities and the ability to switch to breastmilk substitutes much more easily than the others. These practices at a later stage filter down to the others lower in the socio-economic ladder.

The second most significant variable (on order of entry) has been the place of current residence, which is a four-category variable constructed by adding the Dry Zone rainfed area, which was a part of the rural sector, into the urban, rural and estate

categories. As found earlier in the breastfeeding durations, children are more likely to be weaned very early if they are living in urban ares and are more likely to be weaned late if they are living in any of the two rural areas. Despite their low level of modernization and poor living standards, the weaning pattern among the estate children more closely resembles that of the urban than the rural children, particularly those in rural (2) areas with whom they share many socio-economic characteristics and behaviours. For instance, compared to urban children, the relative risk of weaning a child in the estate sector is 80 per cent and it is about 50 per cent in both the two rural areas. The minor differentials observed between the urban and estate dwellers are not statistically significant.

Different reasons account for the similar patterns of weaning demonstrated between urban and rural children. Among the urban children weaning is in general associated with urban lifestyle, and introduction of formula milk at an early age has become a part of that urban life. In the estates, by contrast, early weaning is a result of the pattern of work. Although the labouring population in the estate sector reside on the estate (others who come from nearby villages are not counted in the estate sector), mothers are more likely to be physically away from their infant as they have to work at distant places in the estate. In most of the large estates creches are set up to look after the babies of the working women. At the creches other foods, mainly formula milk, are fed to the babies. When food other than breastmilk is introduced at an early age it will affect adversely the supply of breast milk due to the reduced sucking of the breast by the infant. This is also a strong reason for the early termination of breastfeeding observed in estate areas.

The work status of the mother is also a significant factor affecting weaning. Mothers engaged in `other occupations', mostly in the formal sector, are likely to wean earlier than those not working; the relative risk of a child being weaned among the former is 70 per cent higher than among those not working. Those engaged in agricultural work include two groups: estate plantation agriculture and domestic agriculture. These two groups show two different patterns of breastfeeding and

weaning; the former with a shorter duration of breastfeeding and the latter with relatively longer durations. The net effect of these opposing patterns may have resulted in this group having a similar force of weaning compared with the children of those not working. The tendency of mothers engaged in `other occupations' (those in the formal sector) to wean their children earlier than the other two categories is not an unusual phenomenon as these women are more likely to work outside the home.

The pattern of relationship between birth order and the `force of weaning' is in agreement with that observed at the bivariate level: a tendency for the first born children to be weaned earlier than the others. Mothers of these children are likely to be younger and also to be educated. There is also evidence, but somewhat rare, that primiparous mothers, at least initially, have a very low output of breastmilk (Harfouche, 1970:159), which may also explain part of this observed relationship.

Summary

Among the study population initiation of breastfeeding is universal and there were no significant differences the initiation of breastfeeding according to the socio-economic background of the population. Substantial differences in breastfeeding duration were observed across the socio-economic groups. In general children coming from high socio-economic backgrounds had lower durations of breastfeeding than others. The only noticeable exception was the children in the estate sector who are socially deprived, although economically better off than some of the rural groups as their mothers receive a regular wage. The multivariate approach used showed that economic characteristics are more influential in the force of weaning; the characteristics which significantly influenced the probability of weaning at any age group were housing type and place of current residence (urban, rural and estate) and the work status of the mother, all of which represent the socio-economic status of the household.

There are some overlapping or compounding influences in these poverty-related characteristics of the population. The poor households (with the exception of those on estates) tend to breastfeed longer; probably the poor cannot afford marketed formula

milk, particularly when open market prices are high. Socio-economic differentials were also observed in the patterns of food supplementation. A substantial proportion of children receive food supplements at very early ages, while among many others cessation of breastfeeding is abrupt. The early introduction of food other than breastmilk has been given as the major reason for the growth faltering observed around the fourth month among Sri Lankan children (Soysa, 1988:50).

The patterns observed differed among the four residential areas. The children in the estate sector receive exclusively breastmilk only for a short period and switch to other milk types earlier than those in other residential areas. As the literacy and the socio-economic status of this population group is low and for most of them drinking water also comes from a less than satisfactory source (Chapter 4), it is uncertain how well and how hygienically formula milk is mixed and given to the babies. Urban children also have a shorter duration of breastfeeding but are more likely to receive solids than those in the estates. The children of Dry Zone farmers (rural 2) receive breastmilk for longer durations and the introduction of solids occurs somewhat later than in the rest of the rural areas. Although breastfeeding and weaning is not the only reason, it appears to be a major factor in explaining socio-economic group variations in child growth.

Chapter 7

Socio-economic and Behavioural Influences in Child Undernutrition

7.1 Introduction

In Chapter 5 the nutritional status of children aged 3-36 months was examined for the sample as a whole and for selected background characteristics. The analysis was confined to the bivarate results. The analysis was mainly focused on two nutritional indicators: stunting (low length for age) and wasting (low weight for length). This chapter attempts to examine the effect of socio-economic and behavioural characteristics on undernutrition in the study population. As discussed in Chapter 3 logistic regression is used to analyse the data and two models are fitted, using low length for age (stunting) and low weight for length (wasting) as dependent variables.

7.2 The Study Population and Method of Analysis

The analysis of child undernutrition is carried out treating the child as the unit of measurement. The population under study consists of children aged 3-36 months for whom data on both weight and length are available. Children who were younger than 12 months of age and all multiple births have been excluded from the analysis. Where live birth interval is used as a key explanatory variable, children in the first birth order also have been excluded from the analysis. The exclusion of children under 12 months was made for several reasons. First, the pattern of growth of normal children does not vary significantly at the very young ages as most of them are fully breastfed. Second, stunting, retardation of linear growth, is much less marked during most of infancy. Third, from the age group 1-10 years, weight for length is considered to be less affected by the age of child,[1] and between ages 1 and 5 less affected by the ethnic background

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1 It should be pointed out however that among children under 1 year, at any length the older children are in general heavier than the younger ones; but any bias due to this is assumed to be not severe (Waterlow *et al.*, 1977).

(Waterlow *et al.*, 1977:491). Fourth, eliminating children under 12 months of age automatically minimizes any bias that can arise when linking the nutritional characteristics of an individual child with household characteristics: when the child is taken as the unit of observation there is always the possibility of bias due to several children with similar or different nutritional status coming from one household. In the present case this bias is minimal as only very few households can have two children who are aged between 12 and 36 months. Finally, the elimination of very young children also minimizes the errors in the data as well: as has been seen in Chapter 2, the suspected data deficiencies in length measurements were greater among children of very young ages.

A possible disadvantage of eliminating infants is that the effects which breastfeeding and the start of food supplementation can have on nutrition may not be very noticeable, as their influence on a child's growth is greater in early part of infancy tahn in childhood. The other, perhaps the main disadvantage, is that the early ages of linear growth retardation (stunting) cannot be studied. However, in developing countries the onset of stunting usually begins *in utero* and the SLDHS anthropometric data are available only from three months of age onwards; therefore this is not a serious deficiency in the analysis.

Two models are fitted to the data; one examines the relationships of the predictor variables with stunting and the other with wasting. For the model dealing with stunting the model is restricted to children in birth order 2 or more while in the case of wasting first birth order children were included: this aspect is discussed later in the chapter.

7.3 Logistic Regression Models

Results of the logistic regression models fitted separately for stunting and wasting presented in the following section relate to additive models. The model fitting was however made using two factor interactions restricting only the variables found to be significant in each model at the bivariate level. None of the interactions was found to

be statistically significant. In the presentation of results, bivariate relationships between the explanatory variables and the dependent variables are briefly discussed under each of the proximate variables and socio-economic variables, before the results of the full models are discussed.

7.3.1 Demographic factors and child undernutrition

The following characteristics were considered under demographic factors: maternal age, birth order of child, previous birth interval, and current age of the child. Maternal age affects child nutrition largely through its influence on the growth of the foetus and resulting birthweight. Children born to very young mothers are often found to be immature and `smaller-for-gestation'. Immaturity at birth and nutritional disorders in the later childhood years both reflect the same phenomenon; in the neonatal period it is immaturity and in the postnatal period it is nutritional disorder (Puffer and Serrano, 1973:10).

The relationship between maternal age and stunting alone showed that children born to very young mothers have higher nutritional risks than the others; compared to the children of mothers in their teens (less than 20 years), children born to mothers when they were 30-34, and 35-39 years of age have the lowest nutritional risks. Relatively high nutritional risks are found among children born to mothers before they reach the age of 25 (see Appendix, Table A.7.1). The high nutritional risk at these ages may be due to their lack of preparedness, biologically and emotionally, to begin childbearing. The statistical significance of the association between maternal age and stunting shown at the bivariate level is, however, weak (significant at $p < 0.10$); but the pattern of variation broadly resembles that observed in infant and child mortality in Sri Lanka (Meegama, 1980; Rutstein, 1984).

The observed relationship between the birth order of the child and stunting alone follows an inverted `U' shape, indicating a rising risk of stunting with increasing birth order reaching a peak at birth order 4. At this level the odds ratio is nearly twice that at birth order 2 after which the odds ratio begins to fall, implying a relatively low

likelihood of stunting at very high birth orders. Yet the odds ratios at the higher birth orders are above those at birth orders 2 and 3 (Appendix, Table A.7.1). At the bivariate level, the observed association is significant at $p < 0.05$ level. The influence of this variable begins to cease when other variables, particularly the birth interval, are introduced into the model. Neither of the two variables, birth order and maternal age, retains its significance when both are considered simultaneously. The elimination of children of first birth order and infants from the analysis may have somewhat depressed the strength of the influence of these variables on stunting.

As stated in Chapter 1, short birth intervals have consistently been shown as hazardous to the health and survival of the newborn (Hobcraft *et al.*, 1983; Maine and McNamara, 1985). The relationship observed between preceding birth interval length and stunting is positive: the shorter the birth interval the greater the likelihood of the child being stunted. In a preliminary examination of the relationship between birth interval and stunting detailed categories of birth interval length in months (< 18, 18-23, 24-35, 35-45, and 45 and over) were used. They clearly showed a decreasing proportion of stunted children with increase in interval length. However, the association between birth interval and stunting was statistically significant only if it was longer than 36 months. So the interval lengths between births were categorized into two: intervals below 36 months and 36 months and more. The effect of previous birth interval length on stunting is statistically significant even when the effects of other variables are present in the model.

The nutritional level of the children is also affected by the subsequent birth interval, mainly because of competition for resources and food as previously discussed (Chapter 1). The SLDHS data on weight and length are related to children born in the 3-36 months before the survey, during which time only a very few mothers had more than two live births, even if multiple births are taken into consideration. As the cumulative effect of stunting (low length for age) normally rises with increasing age it is also difficult to judge whether the observed higher prevalence of stunting among the older sibling of the birth interval is due to the effect of the presence of the younger

sibling. Such a comparison also leads to biases in the present case as all children under the age of 12 months have been eliminated from the analysis. As a result no effort is made to examine the possible effect of subsequent birth interval on the index child. In an exploratory data analysis, the relationship between birth interval length and wasting was examined: no significant association was found between them.

As discussed in Chapter 1, there are three major explanations for association between birth interval length and child health, growth and mortality: the maternal depletion syndrome, competition among siblings, and cross-infections. The effect of maternal depletion on wasting is less relevant as the children under the age of 12 months, a group which can be particularly affected by the maternal depletion syndrome, have not been considered in the analysis. So any effect of birth interval length on weight for length should be mediated through the other two factors, competition effect and cross-infections discussed in (Chapter 1). The statistical insignificance observed between birth interval length and wasting implied that such effects, if any, were minimal. Accordingly, birth interval length was not introduced as a predictor variable in the model fitted for wasting. This had an added advantage that children in birth order 1 could be retained in the analysis. However, children under 12 months were still eliminated.

At the bivariate level, among the variables considered under demographic characteristics sex of the child, number of living children, and survival status of the previous child were not found to be significantly associated with stunting. In the case of wasting, except for the age of the child, the associations of all other demographic variables were found to be not significant.

7.3.2 Environmental exposure variables and child undernutrition

Three main indices have been used in the present analysis to represent environmental influences at the household level. They are the main source of drinking water, the availability and type of toilet, and housing type. Despite their doubtful data quality, households reporting diarrhoea in the past four weeks were also used as a proxy for

environmental contamination. The prevalence of diarrhoea did not show a statistically significant relationship with stunting or with wasting at the bivariate level. All of the other variables showed a strong association when they were individually related to stunting (see Appendix Table A.7.1). Apart from toilet facilities the other two variables (housing type and source of drinking water) were found to be significantly associated with wasting even after adjusting for the influences of other proximate and socio-economic variables. The pattern of association with wasting and these two variables is discussed later in the chapter.

The relationship between source of drinking water and stunting is that when the drinking water for the household comes from a safe source, then it is more likely for a child from such a household to be well nourished. It is interesting to note that a child who comes from a household receiving water from a protected well is about 20 per cent less likely to be stunted than those with piped water connected to their houses (Appendix, Table A.7.1). It is even more interesting that the chances of being stunted are higher when the water source is a common or street tap (odds ratio of 1.5 compared to 1.0 whose households had access to piped water) than when water is drawn from streams, ponds etc. (odds ratio 1.1). As has been seen in Chapter 4, the households receiving water from common taps or tube wells are mainly estate workers, rainfed farming communities in the dry zone and presumably, poor groups in the urban areas.

The general pattern of relationship between housing type and stunting shown at the bivariate level is that compared to those in better housing (type 1), children living in poor housing types are more likely to be stunted. The magnitude of variation between the housing types is not very high but it is interesting; children coming from the poorest houses (type 4) are twice as likely as those in better housing (type 1) to become stunted. The presence of a mud floor is common to housing types 3 and 4 and the difference between these two housing types and housing type 2 is that the latter has a cement floor. Thus the odds ratios for these categories show that the presence of a cement floor alone minimizes to a certain extent the probability of a child being stunted.

The association between toilet facilities and stunting shows that children in households with some type of toilet are less likely to be stunted than those without any toilet. Compared to the children in houses without any toilet, those coming from a house with a sanitary toilet are 50 per cent less likely to be stunted. If the household has a non-sanitary toilet (pit type or bucket type), this chance will be reduced by 10 per cent.

The above analysis is based on the relationships observed between stunting and each of the environmental exposure variables alone. Because these variables are highly inter-related and demonstrate different aspects of the levels of living of the households, to a large extent the influences they exert on stunting alone are not present when other socio-economic variables are introduced in the model. As Keller points out, they are non-specific variables of socio-economic status and are by themselves not the cause of stunting (Keller, 1988:20). The influence of source of drinking water on stunting gradually disappears and becomes statistically insignificant when the toilet facilities and housing type are introduced in the model. This is because these three variables represent different aspects of the level of living of the household. The relative influence that toilet facilities exert on stunting diminishes when the housing type is introduced in the model. However, Meegama (1980) found in Sri Lanka WFS data a strong association between toilet facilities and neonatal mortality, and in rural areas he observed that this association was strong even after controlling for factors such as maternal age and parental education.

The influence of housing type on stunting diminishes when both the place of current residence and joint educational level of the parents are simultaneously present in the model. Again, there is a broad correspondence between the housing type and the four residential groups, and the joint educational level of parents also closely reflects the overall level of living of the household. Thus none of the variables considered under environmental exposure emerged as a significant predictor of stunting when the residential groups and the joint educational level of parents were in the model.

In wasting, too, the households with diarrhoea do not show any statistically significant relationship. Apart from the toilet facilities, which were not significant at the bivariate level, housing type and source of drinking water remain statistically significant even after the introduction of other socio-economic variables into the model. The pattern of associations observed is discussed in section 7.10.2.

Unlike the risk in the case of stunting, the risk of wasting is likely to be highest among children where households get water from a stream, pond or similar source. These children are at twice the risk of those living in houses with piped water (connected into the unit or to the premises). The common tap or tube well shows a slightly lower risk than the protected well. The pattern of relationship of toilet facilities with wasting is similar to that between stunting and is statistically significant (Appendix, Table A.7.2).

7.3.3 Health care behaviour and child undernutrition

Sri Lanka has a well developed network of medical and health care institutions spread over most parts of the country. Public health services are also provided by a network of public health staff under a Medical Officer of Health (MOH) who is the head of a health unit in the periphery: there are more than 100 health units in the country. The Family Health Worker (FHW) is the key public health staff member at the grass roots level; one FHW covers a population of approximately 5000. Among the functions of the FHW are the undertaking of field visits in connection with antenatal and postnatal care, confinements and special care. In these visits FHWs are able to identify pregnant women in the area and provide them with information relating to maternity care and food, and to persuade the women to attend the antenatal clinics; they watch out for any abnormal conditions of pregnancy and ensure that such women receive medical attention (Nycander, 1971).

In these visits and at clinics pregnant women who are at high risk, nutritionally and otherwise, can be detected for further attention. At the antenatal clinics, pregnant women who are anaemic and nutritionally deficient are provided with food supplements

and vitamins: currently such women and lactating mothers receive regular supplies of Thriposha. Thus in addition to general pregnancy checkups, the visits by the FHW and attendance at antenatal clinics by mothers should have important implications for the nutritional status of the mother as well as reducing the risk of babies with low birthweight.

SLDHS data on visits to clinics and visits by FHW are somewhat limited in that they refer to visits at least once during pregnancy, and no information is available on the number of times visited, the pregnancy durations, and services or advice received at each visit or the purpose of the visit. Although detailed data on antenatal visits are not available, the visit by the FHW and visits to clinics (or doctors) during pregnancy have been included in this analysis as two basic indices of utilization of antenatal health care. It is interesting to note that neither the FHW's visit nor the visit to a clinic during pregnancy showed any significant relationship with child nutrition, either in stunting or in wasting.

7.3.4 Care during delivery and child undernutrition

The majority (85%) of births in Sri Lanka take place in medical institutions and it is expected that at these institutions high-risk mothers are given special attention and receive additional care at postnatal clinics. Not only does the childbirth take place in a hygienic environment, but also institutional deliveries give exposure to breastfeeding procedures and weaning which have nutritional significance. Thus the place of confinement (whether born in a medical institution or not) and the type of person attending the delivery — medical person, traditional birth attendant (TBA), or other person (including with no assistance) — were also included in the analysis as indices of use of health care at delivery.

These two variables independently show a strong relationship with level of stunting but not with level of wasting. The probability of a child being stunted is 2.3 times as great among children born at home than among those born in hospitals. This variable retained its significance even when the influence of other proximate and socio-

economic variables was taken into account. Similarly, the risk of stunting increases when births take place without medical supervision; compared to a child whose birth was attended by a medical person, those attended by a traditional birth attendant had 1.9 times the risk of stunting, and three times the risk when the birth was attended by other persons or with no assistance. However, the statistical significance of this influence does not persist when place of confinement is introduced in the model because these two factors are interrelated; when a mother is delivered in an institution in normal circumstances the delivery is supervised by a medical person. The influence of these two variables and the antenatal care variables were not statistically significant in the case of wasting.

7.3.5 Vaccinations and immunizations and child undernutrtiion

Sri Lanka has achieved considerable progress in the coverage of childhood immunization. According to recent estimates the coverage has reached as high as 60 per cent. The Sri Lanka Expanded Programme of Immunization (EPI) covers six disease types: tuberculosis, poliomyelitis, diphtheria, whooping cough, tetanus and measles.

The influence of immunization on child nutrition normally works through the health of the child. Children aged 12 months and over were selected for the analysis; whether a child was given a BCG vaccination or not and whether a DPT 3 dose was given were included as two predictor variables in the model. At the bivariate level the relationships observed were significant with stunting but were not significant with wasting. The influences of the BCG vaccination and DPT 3 in stunting do not remain when the influences of place of residence and level of education of the parents are present in the model. Perhaps the full impact of child immunization on nutritional status can only be felt after a certain age and thus it may not visible in the short age interval of three years.

7.3.6 Family planning and child undernutrition

When family planning became a part of government policy in Sri Lanka in 1965, it was amalgamated with the maternal and child health services of the Ministry of Health. Since then, family planning services have been expanded and now family planning services are provided by a large network of medical and health institutions throughout the country. In recent years there has been a remarkable increase in levels of contraceptive use in Sri Lanka; the estimated current use level among currently married women rose from 34 per cent in 1974 to about 57 per cent (excluding the northern and eastern provinces) in 1987 (Department of Census and Statistics, 1988). Sterilization, both male and female, was given priority in the national program in 1982 when financial incentives were offered to the clients and to medical and paramedical personnel for providing the services. Since then its use has increased. Currently one or other of the spouses is sterilized in one third of couples with a wife of reproductive age (Department of Census and Statistics, 1988).

For the purpose of the present analysis, contraceptive use, whether using any modern method or using any traditional method, was introduced as an explanatory variable. The pattern of relationship between contraceptive use and nutrition is as expected; children of mothers who ever used a modern method are better nourished in terms of stunting than those of never-users of contraceptives. There was no significant difference between the traditional method and modern method, both showing similar odds ratios. As with other health care variables the use of contraceptives was significant individually with stunting but was not significant when other socio-economic factors were present in the model. There was no significant relationship between contraceptive use and wasting.

7.3.7 Breastfeeding and weaning

Breastfeeding duration and introduction of supplementary food on a regular basis were also included in the model. As the children selected for the analysis were all 12 months of age or more, the following breastfeeding duration (months) categories were used:

breastfed for less than six months, 6-8, 9-11 and 12 months or more. Similarly, introduction of food to the child on a regular basis was also divided into four groups compatible with the appropriate time for food supplementation discussed in Chapter 5: introduced before 4 months, 4-6, 7-9 and after 9 months. Neither of the variables was significant in either of the models. Probably the elimination of children under the age of 12 months from the analysis may have depressed the strength of the actual influence of these two variables on the nutritional level of the children.

Several studies carried out elsewhere have addressed the issue of the association between breastfeeding and nutritional status among children, but have come up with differing conclusions. In Bangladesh, a study of 1087 children 12-36 months of age reported that the mean weight of breastfed children was slightly lower than for non-breastfed but the risk of dying was found to be six times higher among the non-breastfed children than those breastfed even after controlling for factors such as age (Briend and Bari, 1989). Similar results were reported from Ghana (Brakohippa *et al.*, 1988) where breastfeeding beyond 19 months was found to be associated with undernutrition.

Most such studies conducted in various parts of the world, however, as stated in Chapter 1, suffer from various biases due to methodological flaws and problems in the study design. Mostly these studies relate to hospital or clinic-based samples and, as a result, they relate to generally less healthy children who are different from normal children who are also breastfed. Their breastfeeding and growth are affected by their poor health so any negative association between breastfeeding and growth may be complicated by this fact. However, studies of children made using random samples have also reported negative associations between breastfeeding and child growth. These associations are, however, influenced by various factors such as the pattern of breastfeeding, food supplementation and socio-economic environment, all factors which should be taken into account when interpreting the results. Therefore the negative associations should not be taken as causal associations (Greiner, 1979:2). In many instances undernourished children and prolonged breastfeeding are found to operate in

the same environment: among the poor, breastfeeding duration is relatively long. It is possible that mothers introduced food supplements only after realizing their children were not growing well. Possibly there is a third factor - poor socio-economic status - responsible for both longer breastfeeding and undernutrition.

7.3.8 Socio-economic characteristics and child undernutrition

As was discussed in Chapter 5, the association between stunting and residential areas was significant ($p < 0.001$, Appendix, Table A.7.1). The level of stunting varies widely between the residential sectors; estate children being the worst and urban children the least affected. The range of variation is such that the estimated odds ratio for estate children is about 6.2 times the urban; in the second worst residential area, rural (2), it is about twice the urban ratio. The observed differentials between urban and rural (2), and urban and estates, at the bivariate level are highly significant. In the case of wasting variations there are variations between residential areas, but they appear minimal; the odds ratio for rural (1) is 1.2 and for rural (2) is 1.8 times the urban; the estates were not included in the analysis because of their extremely low prevalence of wasting. The overall significance of the association between residential areas and wasting is found to be weak ($p < 0.05$) and the observed differentials between the categories are not significant (Appendix, Table A.7.2).

The association between the educational level of both parents, taken jointly, and stunting has also been examined and was found to be highly significant ($p < 0.001$). It clearly shows how the prevalence of stunting progressively decreases with the increase in the educational level of the parents; compared to children whose two parents are least educated (primary or lower), those of parents who both have a higher than secondary level of education (category 5) have only a 20 per cent chance of being stunted; those of both parents with secondary level education will have a 40 per cent chance of being stunted. The relative influence of parental education on stunting is however the same (odds ratio 0.4) for children of whom both parents have a secondary

level[2] (Appendix, Table A.7.1).

Although religion of the mother did not show a significant association with wasting it was highly significant ($p < 0.001$) with stunting at the bivariate level. Compared to Buddhists, the prevalence of stunting is greater among the Hindus, the odds ratios for the latter being 4.5. Differentials in the prevalence between these two groups are significant. Although cultural factors can have an important influence on child nutrition in various ways such as in breastfeeding and food supplementation, food intake and their types during pregnancy etc., the observed high prevalence of stunting among the Hindus is largely a reflection of the influence of the estate population; the overwhelming majority of the Hindus in the study population are in the estate sector.

7.4 Discussion

The foregoing analysis showed that among the variables examined in the two models the influences of a few proximate and socio-economic variables were significantly associated with the dependent variables. These variables were not, however, identical between the two nutritional indicators largely because they are not correlated with each other (Keller, 1988). Besides, as indicated in Chapter 3, these two indicators represent two different types of undernutrition; stunting indicates a long-term undernutrition while wasting is an indicator of current or recent undernutrition due to the effects of more recent health and dietary problems. The causes of the two types are not necessarily the same (Waterlow, 1979) but in general an inadequate supply of energy and nutrients, and infections are the common causes (Martorrel, 1985). The main findings should be discussed separately according to the type of undernutrition.

Table 7.1 gives a summary of the results of the two logistic regression models fitted for the two indicators of nutrition for the study population as a whole. For the model for stunting, children under 12 months of age and first-order births were

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2 For the final models parental (joint) education was introduced rather than the maternal or paternal education. Partly because it has the influence of educational level of both of the parents which can be used as an indicator of overall socio-economic level of the household.

eliminated, while from the model for wasting, estate children and those under 12 months were excluded, but first order births were included.

Table 7.1 Variables significant in the logistic regression model for stunting and wasting.

Variable	Stunting	Wasting
Age of child	significant	significant
Previous birth interval	significant	not significant*
Place of residence	significant	not significant
Level of education of both parents	significant	not significant
Source of drinking water	not significant	significant
Housing type	not significant	significant
Place of confinement	significant	not significant

* not included in the current model.

7.4.1 Stunting

For stunting, among the variables considered in the models five were found to be significant: in order of selection, place of current residence, joint educational status of the parents, previous birth interval, age of child and place of confinement. When adjusted for the influences of other proximate and socio-economic variables, place of current residence emerges as the most significant ($p < 0.001$) variable predicting stunting among children aged 3-36 months. Of the four categories examined the estate sector stands out as the most severely affected. The differentials between the urban and estate sectors are significant ('t' value approaching 4.4). The odds ratio for estate children is about 4 times the urban, which is less than what was observed before it was adjusted for other factors. In general children living in urban areas have an advantage in that the urban sector has the lowest prevalence of stunting. There is not much difference between the urban and rural (1) areas, perhaps reflecting the lack of socio-economic differentiation between the two areas. Although they are not statistically significant, there are noticeable differentials between the urban and rural (2) areas: the odds ratio for rural (2) area is 1.4 compared to 1.0 in urban areas. As discussed in

Chapter 5, the excessively high level of stunting in the estates is the result of generations of deprivation experienced by the community. Similarly those in the dry zone rainfed farming areas are a deprived community consisting largely of the landless poor living in formerly malaria infected regions.

Table 7.2 Logistic regression parameters relating proximate and socio-economic variables to stunting* among children 12-36 months old who are in birth order 2 or more, SLDHS, 1987.

Variable	Estimate	S.E.	t values	Odds Ratio
Place of residence		**(χ^2= 29.6 @. 3 df) p < 0.001**		
Urban	0.00	-	-	1.0
Rural (1)	0.13	.222	0.6	1.1
Rural (2)	0.32	.263	1.2	1.4
Estate	1.29	.293	4.4	3.6
Parental education (joint)		**(χ^2= 27.9 @ 4 df) p < 0.001**		
Both primary or less	0.00	-	-	1.0
One primary or less, the other above	-0.06	.190	-0.3	0.9
Both secondary	-0.57	.217	-2.6	0.5
One secondary & other higher	-0.71	.216	-3.3	0.5
Both higher	-1.14	.280	-4.1	0.3
Birth interval (months)		**(χ^2= 7.3 @ 1 df p < 0.01)**		
Under 36	0.00	-	-	1.0
36 & over	-0.38	.142	-2.7	0.7
Age of child (months)		**(χ^2=12.3 @ 3 df**		**p < 0.01)**
12-17	0.00	-	-	1.0
18-23	0.40	.197	2.0	1.5
24-29	0.30	.196	1.5	1.3
30-36	0.67	.193	3.5	2.0
Place of confinement		**(χ^2=4.2 @ 1 df**		**p < 0.05)**
Hospital	0.00	-	-	1.0
Home	0.39	.193	2.0	1.5

Total deviance (final model) 1227.2 @ df1017

df = degrees of freedom

* Z-scores -2.00 or below the WHO/NCHS median are considered stunted.

Another statistically significant socio-economic variable is the joint educational level of the parents derived by considering the educational level of the husband and

wife. The final results of the model indicate clearly the declining odds ratios when the educational level of the parents increases. For instance, when both spouses have a higher (above secondary) level of education the likelihood of a child being stunted decreases to 30 per cent of the level found among the group where both parents have primary level or no formal education at all (Table 7.2). However, there is no noticeable reduction in stunting even if one of the parents has a higher level of education while the other has secondary level: odds ratios for the two groups are estimated at 5.

There is a close correlation between the mother's education and father's education which is more pronounced across the extreme educational categories: lowest and highest. Thus the variable parental (joint) education incorporates the influences of both the mother and father and may be a better indicator of the total household socio-economic status.

As speculated in Chapter 4, the joint educational level of the parents may perhaps best represent the overall socio-economic level of the household. This is also confirmed by the fact that the influence that housing type (which was used as a proxy for socio-economic status of the household) had exerted on stunting was depressed largely by the parental education variable when it was introduced in the model.

The birth interval effect on stunting is clear: if a child was born within a short period after its elder sibling then there is a greater chance of that child, even both children, being undernourished. Interval length between births used as a two-category variable, i.e. birth interval less than 36 months, and 36 months and over, in the model showed that a birth interval shorter than 36 months is associated with higher risks of stunting than are longer intervals (Table 7.2). Three factors — maternal depletion, cross — infections and competition — are assumed to be explanatory factors that mediate between the birth interval length effects and the health and survival of the children (Chapter 1). An assessment of the relative roles of each of these factors is, however, difficult from the available data.

If the number of living children of the mother and the birth order of the child are

taken as suitable proxies for family size, then these two variables can be used to examine the possible effects of competition between the children for scarce resources, maternal time and care. Although weak, these variables also can be used to assess the cross-infection effects as well. The effects these variables exert on stunting were found to be negligible and were statistically insignificant. On this basis, although inconclusive, one can speculate that neither competition effects of birth interval nor cross-infection effects are noticeable among the study population. It should be remembered that the study did not consider first birth-order children and those under the age of 12 months. Obviously, first order births are not effected by competition or cross-infections.

The major influence of birth interval length on stunting could be largely due to the deleterious effects of maternal depletion syndrome. The signs of stunting observed even before the child is six months old may also confirm the fact that late prenatal and early postnatal effects strongly influence the linear growth retardation of children. According to Mata (1978), in developing countries the birthweight itself is a decisive factor shaping the future status of the stature of children.

Another study in India found that children who were stunted at the age of five were also stunted at age 17. The increase in growth of these children between these two points was similar between children who were stunted and those who were not (Satyanarayana, Krishna and Narasinga Rao, 1986). These findings also suggest that status of early childhood growth is a determining factor in adult stature in certain developing areas of the world.

As discussed in Chapter 5, prevalence of stunting increases with the age of child. Soysa and Waterlow (1981) have warned that this pattern could be largely because of the cumulative nature of the influence rather than the true nature of the prevalence at older ages; to ascertain the actual growth retardation in each age one needs to look at growth velocities.

Place of confinement also emerged as a significant factor in predicting stunting

(Table 7.2). As stated above, despite the high level of institutional births in Sri Lanka, the group of people who seek institutional care during confinement are in general the modernized sections of the community (Appendix, Table A.6.3). It has been suggested that mothers who give birth in hospitals are more likely to provide home care for the child adequately, and it is assumed that the maternal ability to provide health care affects the survival of the newborn for about 2-6 months (Butz, DaVanzo and Habicht, 1982). Immediately after birth endogenous factors are influential. In the case of nutrition it is doubtful how the effects of `ability to provide care' operate in the second half of infancy and beyond, when food supplementation and weaning are taking place. It may be possible that mothers who give birth in hospitals are also the ones attending clinics and are more likely to receive advice relating to nutrition and possibly to receive food supplements for themselves and their children.

Overall, the results of the model indicate that demographic and socio-economic factors are the key predictors of stunting. In the absence of data on income, which is somewhat difficult to obtain using a few questions in a survey like SLDHS, characteristics such as parental (joint) education or housing type would be important proxies for socio-economic living conditions. For practical purposes the four residential types are distinctive socio-economic sectors.

7.4.2 Wasting

Three variables have been identified as strong predictors of wasting: age of child, source of drinking water, and housing type.

Among children aged 12-36 months, wasting is highest in the 18-23 age group. Results of the model presented in Table 7.3, show that the odds ratio among this group is 1.1 times the 12-17 months old children. As discussed earlier, wasting begins to appear when breastmilk is not adequate to meet the nutritional needs of the growing child and the nutrient gap is not properly supplemented. During this stage the child is particularly vulnerable to infections. Low food intake and infections go hand in hand causing weight losses and low weight gain in this period. The occurrence of infections

also demands more energy and nutrients.

Table 7.3 Logistic regression parameters relating proximate variables and socio-economic variables to low weight for length (wasting)* among children aged 12-36 months (excluding estate sector).

Variable	Estimate	S.E.	t values	Odds Ratio
Age of child		**(χ^2= 16.3 @ 3 df p< 0.001)**		
12-17	0.00	-	-	1.0
18-23	0.06	.201	0.3	1.1
24-29	-0.52	.225	-2.3	0.6
30-36	-0.72	.237	-3.0	0.5
Source of drinking water:		**(χ^2= 12.4 @ 3 df p < 0.01)**		
Piped (into premises)	0.00			1.0
Public tap/tube well	0.52	.417	1.2	1.7
Protected well	1.06	.389	2.7	2.9
Unprotected well / streams/ponds	0.80	.404	2.0	2.2
Housing type		**(χ^2= 7.6 @ 3 df p < 0.01)**		
Type 1	0.00	-	-	1.0
Type 2	0.40	.215	1.9	1.5
Type 3	0.46	.292	1.6	1.6
Type 4	0.52	.206	2.5	1.7

Total deviance: 1048.8 @ 1271 df

* Z-scores -2.00 or below the WHO/NCHS median are considered stunted.

Thus wasting begins to rise from the early months of life and its peak prevalence coincides with the period of weaning; thereafter wasting tends to decline. By this age children who survived the peak age of wasting are able to catch up and achieve almost normal weight for their attained length with the transition to the normal family food, which is possible as a child will now have a full complement of teeth.

Apart from the age of the child, the two variables significantly affecting wasting are source of drinking water and housing type, both included as environmental exposure variables, although they have socio-economic elements as well. The emergence of source of drinking water as a significant ($p < 0.001$) variable probably reflects more an environmental effect than a socio-economic one: the effect of water supply on the

nutritional level of the children comes from the relationship between drinking water and infections. The pattern of association between wasting and source of drinking water is interesting; children in households with access to piped water are less likely to be wasted and, by comparison those in households getting water from public taps or street taps show slightly higher risks (albeit not significant). Interestingly, children in households drawing drinking water from protected wells show nearly three times the risk of being wasted whereas those getting water from unprotected wells or stream and ponds have a relatively lower (odds ratio of 2.2) likelihood of being wasted (Table 7.3). The pattern of hygienic practices in the use of water among the study population is not known, but it may be that when water is drawn from an unprotected source they are aware of the possible danger and take extra precautions such as boiling it. On the other hand households with access to water from a protected well may think that the water is clean and not take care in using it.

In Sri Lanka, despite the methodological problems associated with his study briefly discussed in Chapter 1, Patel (1981) found a slightly higher infant mortality associated with piped water than with well water, which he attributed to the possibility of contamination of tap water. Similar evidence has been found elsewhere: for instance, in the Philippines, Cabigon (1990) found slightly higher infant mortality among children in households with access to safe water (piped, street taps, and protected well) than among those receiving drinking water from other sources. She speculated that this could be due to behavioural factors, such as boiling water, which may be not related to the socio-economic status, and also due to possible contamination of water in transporting and storing, even if the original source of that water may be safe. Similar findings were also reported from the longitudinal study of Cebu in the Philippines (Cebu Study Team, 1990). Thus the observed association between the source of drinking water and wasting should not be considered as a data problem but should be viewed as a reflection of the socio-economic development of the community, public health consciousness and hygienic practices among the population.

It is recognized that malnutrition and infections are interrelated, and unsafe

water is a common cause of infections, primarily diarrhoea and gastro-enteritis. Thus the source of water supply is a determinant in `wasting' among children and this is particularly so when formula milk is prepared using unsafe water. No data are available from the SLDHS to determine hygienic practices in the preparation of formula milk for the infant but it could be possible that the observed relationship between the source of water supply and wasting is mediated by infections. In a two year follow-up study carried out in St Lucia, West Indies, Esray, Feachem and Hughes (1985) found that the relationship between water supply, sanitary facilities and health of children is mediated by infections. In this control study of selected areas with similar socio-economic and breastfeeding habits, they reported that improvements in water supply and sanitary toilets significantly reduced the incidence of infectious diseases and improved the nutritional level of children (Esray *et al.*, 1985:764; Henry (1981)). Similar findings have been reported from Colombia by Koopman, Fajardo and Bertrand, (1981). Infections generally reduce the appetite of the child, which makes for reductions in intake; while some population groups, mainly for socio-cultural reasons, do not give food when the child is sick. All these lead to weight losses (Mata *et al.*, 1978).

In a study in rural Nigeria, Tomkin and others (1978:241-2) observed wasting to be more common (40 per cent) among those with unprotected water supply sources than with protected water source. Stunting, however, did not differ significantly between the two groups. Another study in Brazil (Victora *et al.*, 1986), which covered 802 children aged 12-36 months, showed a close association of environmental factors with stunting and wasting: it was found that children are more likely to be stunted in households without piped water and more likely to be wasted if the drinking water is obtained from a well. It was further observed that poor length and weight were associated with poor housing, and these associations were attributed to poor environment which increases the risk of infections (Victora *et al.*, 1986:307).

In the present study, housing types also show a significant but modest relationship with wasting; children coming from housing type 1 (better housing) have the lowest risk of being wasted. Although the odds ratios are not very high, wasting

tends to increase with the deterioration of the housing.

7.5 Identification of the Vulnerable

From the results of the logistic regression models it is possible to identify the groups of children who are vulnerable to undernutrition, in terms of stunting and wasting, according to socio-economic and behavioural characteristics. Such an identification will help allocation of limited resources in the most effective manner to prevent undernutrition.

When low length for age is differentiated by the place of current residence, the children in the estate areas are the most vulnerable followed by the children in the rural (2) areas. In terms of level of education of parents, children born to parents whose joint educational level is less than secondary are more at-risk of stunting than others. Similarly, children born after a space of less than 36 months have a high risk of low length for age. Children born at home are also more at risk of being stunted than those born in hospitals. In the case of wasting, the age of the child is significant; unlike stunting where the prevalence increases with age, wasting is concentrated at 12-17 months as children in the weaning age are at high risk of wasting. Children in households getting drinking water from wells, whether protected or not, and other sources such as rivers, ponds etc., are at high risk of low weight for length (wasting). Similarly, those living in houses with mud floors, whether or not the roof or walls are of durable material (i.e. housing types 3 and 4), are particularly at high risk of wasting.

As has frequently been discussed in the research there are wide variations in the socio-economic, behavioural and nutritional status across the four residential areas. In order to test if the model estimated from the whole sample was the same in each of the residential areas, a conservative test based on the maximum likelihood ratio test statistics was performed. In practice this involves finding the difference in deviance between a model with common slope for all residential areas, and the models with different slopes in each of the residential areas. The resultant test statistics for the two dependent variables were: 36.1 (χ^2) with 28 degrees of freedom for stunting, and 18.9

order to test if the model estimated from the whole sample was the same in each of the residential areas, a conservative test based on the maximum likelihood ratio test statistics was performed. In practice this involves finding the difference in deviance between a model with common slope for all residential areas, and the models with different slopes in each of the residential areas. The resultant test statistics for the two dependent variables were: 36.1 (χ^2) with 28 degrees of freedom for stunting, and 18.9 (χ^2) with 8 degrees of freedom for wasting. These results are not significant at the $p < 0.05$ level. On the basis of these results, it can be concluded that the model involving the variables was the same for each of the residential areas. This does not mean, however, that the separate models are not needed for the different residential areas.

Summary

This chapter has examined the effects of socio-economic and behavioural characteristics of the child on child undernutrition among the study population. Undernutrition was examined in terms of both stunting and wasting. The variables included in the analysis were classified into demographic, environmental, health care and socio-economic categories. The study population consisted of children aged 12 months to 36 months. For stunting first-order births were excluded, but they were included in the model for wasting.

Except for the place of confinement, which was significant only with stunting, all other variables considered under health care were found not to significantly influence both these indicators of undernutrition. Mostly the effect on the level of mortality and the pattern of infant mortality in Sri Lanka is such that the majority of infant deaths take place in the first month and therefore the full impact of the health services on nutritional level is not seen.

The absence of a significant association between clinic attendance during pregnancy, the visit by the FHW during pregnancy, and nutrition does not imply that the services provided at the antenatal stage are not important. An international workshop on child survival held in Mexico also discussed this subject and recognized

to notice the effect of certain childhood immunizations, such as measles, on nutrition a period longer than three years is necessary. Also when the coverage of immunization is at a high level, such as in Sri Lanka (Chapter 4 and also Boerma *et al.*, 1990), there can be a `herd' immunity effect, where there are very few non-immune children left to spread the disease.

The months of breastfeeding and the source of drinking water did not show a strong association with either of the dependent variables. The effect of breastfeeding on child growth is normally seen in the first few months of life when growth is rapid and supplementations are minimal. It may be that for the population under study, children 12 months to 36 months old, the effects of breastfeeding are less relevant. Moreover the details of the data available on breastfeeding and food supplementation are not adequate for a more precise analysis.

Overall, stunting is most significantly influenced by demographic and socio-economic characteristics. Place of confinement also has an indirect effect on the nutritional level of children, and signifies the socio-economic position of the household. The emergence of joint educational level of parents, rather than the mother's education, as a significant variable with stunting is also an indicator that the household's overall socio-economic status rather than maternal education *per se* is relevant. The association between long-term undernutrition and the interval between births was clearly evident in the data, although only the long interval of three or more years was shown as having statistically significant beneficial effects.

In the case of wasting, by contrast, other than age of child all other variables which showed a statistically significant relationship were environmental: housing type and source of drinking water. In several respects the high prevalence of wasting among children at the weaning age could be considered the effect of infections and relates also to the underlying effects of environmental conditions.

The statistical test carried to see whether the models for the sample as a whole are adequate for the four residential areas, showed that they are largely the same for all

residential areas. However, for the purpose of policy planning the development of separate models for the residential areas may be important in the future. For this purpose, it will be necessary to have a larger number of observations than were available from the SLDHS for these areas and more detailed data on the independent variables.

Chapter 8
Concluding Observations

Undernutrition in Sri Lanka shares common characteristics with the situation in other South Asian countries where a large proportion of children are affected by long-term undernutrition. The present study showed that one in about every third child in the 3-36 months age group in Sri Lanka is stunted, showing failure to reach the required length of an average child of the same age drawn from the WHO-NCHS reference. Similarly, one in about nine children revealed deficiencies in weight for attained height (wasted) compared to the reference population. The level of wasting is low compared to stunting but is high by global standards. This research is focused on those children considered undernourished according to the two indicators mentioned above.

This study first of all discussed the changes in the decades-long welfare policy and the food rationing scheme after 1977, and showed evidence that, although overall economic growth in Sri Lanka improved, the living standards of the poor were adversely affected by these changes. The earlier policies, food rationing in particular, guaranteed a minimum quantity of food to the poorest of the poor and acted as a buffer to protect them. Thus a study of recent socio-economic and behavioural determinants of undernutrition is much needed.

This research is based on the anthropometric data collected by the SLDHS in 1987 as part of a international research program. This is the latest survey of anthropometric information available from a nationally representative sample (except for the omission of northern and eastern provinces owing to the political disturbances there) and the first ever data collected in Sri Lanka simultaneously on fertility, including detailed birth histories of the respondents; contraceptive use; utilization of antenatal care; care received during delivery; breastfeeding and food supplementation; and immunization, together with a wide range of socio-economic information relating to children, their parents and the households. The survey, however, did not include direct

data on the household income level but had several items which could be used as proxies.

This research study had a number of objectives: it examined the levels and differentials in child undernutrition according to the type of undernutrition; it identified the population at risk of undernutrition according to their socio-economic and behavioural characteristics; it observed the pattern of breastfeeding and weaning, and socio-economic determinants of weaning, and it examined sex differentials in nutritional levels among children.

Before approaching the data it was necessary to examine briefly the quality of data, particularly that relating to the areas of the present research. Attention was particularly paid to the age reporting by the mother and some aspects of the quality of the data of length and weight measurements. The age data of the respondents and children were found to be satisfactory, but there were some irregularities in the reported anthropometric measurements. There was evidence of possible errors in the data owing to digit preference in the measurements reported by individual measurers. This bias was found to be greater in the length data than in the weight data; the length data were noticeably more unsatisfactory for infants than for children at other ages. Therefore, this and other reasons, children under the age of 12 months were excluded from the logistic regression models.

In the assessment of undernutrition, low length for age (stunting), low weight for age (underweight) and low weight for length (wasting) were used as indicators of nutrition. As the indicator of underweight is influenced by both stunting and wasting, the latter two are identified as suitable indicators to be used in the research study. These aspects relating to the choice of indicators are discussed briefly in the third Chapter. By selecting these two indicators, this research had the advantage of examining the past or long-term growth retardation (stunting) and the more recent growth deficiencies (wasting) among the study population. For the purpose of comparison of data on observed weight and length, the WHO-NCHS growth reference

was used. Available evidence justifying the use of an international growth reference not as a standard *per se* but as a yardstick for comparison was discussed. A z-score -2.00 or below was used as the cut-off point separating the undernourished from the betternourished. In the examination of undernutrition, the mean z-scores and the percentage of children below the cut-off point were used as the principal measures. Z-scores —3.00 or below were regarded as severely undernourished. In addition to the assessment of children according to the type of undernutrition — stunting and wasting — the level of nutrition among the children was assessed using a classification known as the `Waterlow Classification'. The assessment of nutritional status and its variations by age and sex and residential areas were discussed in Chapter 5.

Chapter 6 examines in detail the levels of and socio-economic and behavioural differentials in breastfeeding using the reported breastfeeding durations. Children born in the 3-36 months before the survey were used for the analysis. Most of these children were being breastfed at the time of the survey. The conventional life table approach was used to examine the breastfeeding durations and their socio-economic and behavioural variations. Next, an attempt was made to explore the age patterns of children in relation to the introduction of various food items, such as formula milk, cow's milk, rice cunjee, eggs, and potatoes, using the reported data by the respondent on age of the child at which such foods were given. This information was used mainly to explore any differentials in the introduction of these foods between four residential areas. Such data on the children's ages at the introduction of various food items by the mother are frequently subject to problems of inaccuracies. The possibility of this bias is recognized in this study, but it is, if anything, minimal as the data used in the analysis relate only to the most recent births. After the breastfeeding durations and age patterns of food supplementation were discussed, the socio-economic determinants of weaning were examined through fitting a proportional hazard model to the current status data on breastfeeding. There was no attempt at extending the life table approach using Cox's regression as there was clear evidence of concentrations of reported breastfeeding durations at certain digits. Thus the data used for the hazard model were more accurate

as they concerned only the responses on whether or not the child was breastfeeding at the time of the survey. The analysis was, however, restricted to the lastborn children in the three-year period before the survey, although there were some observations of a possible bias in selecting the last birth only without taking into account the experience of the other children belonging to the same cohort.

As the nutritional status of a child is considered a dichotomous variable, a logistic regression was used to assess the influence of socio-economic and behavioural characteristics on the undernutrition of children. Two models were fitted separately for the two indicators of undernutrition — stunting and wasting. The final models were additive models as the two factor interactions examined, using only the variables significant at the bivariate level, were found to be not significant. The results are discussed in Chapter 7. Logistic regression results are also used to highlight the relevant associations observed between the different variables considered under the proximate determinants and socio-economic variables with the dependent variable at the bivariate level. From the results of models for stunting and wasting, children who are likely to be at risk of undernutrition were identified.

In Chapter 4, the socio-economic and behavioural characteristics of the study population were examined according to the place of current residence; by socio-economic zone and urban, rural and estate sectors. The examination of various indicators has revealed that the developed zones, such as Zones 1, 2, and 3 share more similar characteristics than the least developed zones, Zone 5 (mainly estates) and Zone 7 (dry zone rainfed farming area). Zone 1 is overwhelmingly urban and Zone 2 consists of a sizeable urban population and more developed rural areas. The majority of the estate population is concentrated in Zones 4 and 5. Because of this close association between the socio-economic zones and urban, rural and estate sectors, zone 7 almost always showed a pattern different from that of the developed zones in many socio-economic and behavioural indicators examined; a four-category variable was devised to represent place of current residence by separating Zone 7 (defined as rural (2) from the rural areas; the new classification included urban, rural (1) , rural (2) and estate. When

the four-category residential areas were in the model, the socio-economic zone was no longer required.

The study showed an increasing tendency of a child to be stunted in the transition from a more developed and modernized area to a less developed, less urbanized area; the percentage of children stunted was exceptionally high in the estates, the home of the least modernized and least developed population group. The overwhelming majority of inhabitants in the estate areas are descendants of immigrant labourers from South India. The second highest prevalence of stunting was found among the rural (2) areas. The prevalence of wasting was, however, negligible in the estates, but relatively high in the other areas. The exceptionally high level of stunting among the estate children was discussed in Chapter 5 and was attributed to adaptation to adverse conditions stemming from generations of deprivation (they were drawn from poor areas and were paid low wages, and lived poor for generations) and virtual absence of integration with other communities.

As discussed in Chapter 6, children in both urban and estate sectors had relatively shorter durations of breastfeeding than the two rural groups. In urban areas the breastfeeding duration of an average child was found to be short, but infants used to receive breastmilk substitutes and other supplementary food to compensate for the short duration of breastfeeding, and thus maintain an adequate growth. The early weaning of babies is a characteristic of the urban life style. Urban mothers are more knowledgeable than others about the nutritional requirements of infants, appropriate weaning food and their availability, and have easier access to such foods. They are also more likely to have access to safe water and to be more hygienic than the others. Children of socio-economically better-off groups were found to have short breastfeeding (Chapter 6), but those with mothers who were urban, better educated, living in satisfactory housing and giving birth in institutions, despite early weaning, did not show adverse nutritional outcomes as did the children of less privileged groups, with less access to health care and living in poor environments.

Early weaning by estate mothers is simply due to the employment system which makes them return to full-time work and their subsequent work pattern which does not favour long durations of breastfeeding. The working mother in the estate finds it difficult to breastfeed the newborn as the type of her work requires the physical separation of mother and baby during working hours. Unlike the urban sector where the majority of children are given food supplements (Chapter 6), estate children are less likely to receive supplementary foods at the appropriate time (during 4-6 months). They do not receive adequate food supplementation during infancy due to either the ignorance of their mothers, to lack of time for preparation or cultural reasons. Thus the deprivation (discussed in Chapter 5) and lack of appropriate food gradually cause the retardation of growth. Although the estate children usually do not show a higher level of wasting, its prevalence was very high among the children at the weaning age. The apparent high level of stunting among the children in the less developed rural (2) area can also be explained by relative deprivation and the late introduction of food supplements. Unlike those in the estate areas who mainly depend on formula milk, those in rural (2) areas receive a longer period of breastfeeding but without much supplementation.

The joint education of the parents is negatively associated with the level of stunting; the likelihood of a child being stunted is high among the children whose parents have at least secondary education. This variable emerges as a strong predictor of stunting mainly affecting the socio-economic level of the household. The age of the child as stated earlier is a reflection of the cumulative effect of growth faltering which can begin even before birth, and relative slowness in gains in length.

Despite the exclusion of children under 12 months of age, the interval length between live births is a strong predictor of stunting after adjusting for other variables. The statistical significance of effect of place of confinement on stunting should be treated as a correlation rather than a causal relationship because nutritional status and place of confinement are both mediated by a third factor — the socio-economic status of the household.

In the case of wasting, the influence of the two environmental exposure variables, housing type and the source of drinking water, was found to be strong. The age of the child also retained its significance because of the high prevalence of wasting at the weaning age.

The statistical association between the environmental exposure variables and wasting was treated in this study in terms of their perceived health effects rather than socio-economic significance. This study has showed that source of water supply is strongly associated with wasting; a low level of wasting was most strongly associated with piped water followed by a common tap or a tube well. Interestingly, the relationship showed that children in households drawing water from protected wells are at slightly greater nutritional risk than those getting water from unprotected wells and other unsafe sources. In an attempt to explain this anomaly it was speculated that, when water is taken from a known unsafe source, special care is taken in using it, i.e. by boiling. Alternatively, it is possible that, although a well is protected by a wall the water is not as safe as expected, although no data were available from the survey to substantiate this.

The findings of Patel (1981), despite the problems associated with his analysis and methodology, and those from the Philippines (discussed in Chapter 7) suggest that the observed associations between the different sources of water supply and wasting are not due to problems in the data. More research is necessary before any firm conclusion can be drawn on the association between sanitary and water supply variables with child undernutrition. Any such studies should take into account behavioural factors such as habits relating to usage of water and hygienic practices relating to preparation of infant food etc., as they most probably can have an independent effect of the socio-economic background of the population.

Sex differentials in child under-nutrition have been examined using three indicators of undernutrition. Overall, there is no significant differential in under-nutrition between the sexes. Probably because of their biological advantage, girls

showed a relatively better nutritional level than boys during infancy, although, compared to the reference population, the nutritional level of both boys and girls declines as they grow older. The relative decline is slower for boys than girls, and after 24 months boys showed an advantage. This pattern of growth between the sexes implied the possibility of existence of preferential care in their favour of boys. The breastfeeding durations examined in Chapter 6 also showed an early introduction of weaning food for boys.

According to the `small but healthy' hypothesis, stunted but not wasted children, who are frequently found in the estates areas, are healthy as long as they do not show any functional impairments. Vital statistics and cross-sectional surveys have consistently shown that estate death rates, particularly those of infants and children, are higher than those in the urban and rural areas (Meegama, 1980). For instance, Meegama using SLWFS data has demonstrated that, for the 1959-74 period, the neonatal mortality in the estates (80 per 1000 live births) is more than twice that in the urban areas (30 per 1000 live births) or rural areas (34 per 1000 live births). Postnatal and child mortality were also higher in the estates than in the other two areas, although the range of differentials is not great (Meegama, 1980:20, Table 8). SLDHS data also confirmed that the estate mortality rates are the highest; infant mortality in the estates was 58 per 1000 live births, compared to 32 per 1000 for the sample as a whole, for the 10-year period up to one month preceding the interview (Department of Census and Statistics, 1988:97, Table 6.2). The empirical evidence supporting the hypothesis that stunting increases the risk of morbidity and mortality suggests that the stunted children are not just a short group but a group of children who have failed to achieve their full growth potential. It may be that severely undernourished children may fail to survive infancy and pre-school ages, and, of those who manage to survive (not necessarily the fittest), many may continue to show deficiencies in growth with advancing age. Even if they survive to adulthood, they will most probably lead a poor quality of life. It is unfortunate that the small number of observations (total 1966) in the whole sample and even fewer numbers in each of the residential areas does not permit the examination of

the sibling mortality pattern and its association with the nutritional status of the index child, at the household level.

From the results generated by the two logistic regression models, certain categories of children (Chapter 7) who were more likely to be at risk of undernutrition, in terms of stunting and wasting, have been identified. For policy intervention purposes, however, it is necessary to identify `the context in which deprivation occurs' without which governments cannot develop strategies to prevent undernutrition (McLean, 1987:393); not only the characteristics of vulnerable groups but also suitable indicators of vulnerability, indicators which capture the most at risk groups. These can be used as guidelines by the health workers at the periphery; this will give an effective coverage of mothers and children who would be at high risk of undernutrition. In this research an exploratory effort was made with an indicator of housing type developed using the reported data on the materials of construction of the walls, floor and roof. This approach undoubtedly has problems associated with lack of detailed information on the materials used and their durability; for instance, wood may be an inferior material used in the poorly built squatter's hut or it may be a material used in the well-built house of a well-to-do person (United Nations, 1969:27). Although, the approach cannot claim to be perfect, it nonetheless gave a reasonable classification of households according to broad socio-economic groups, particularly the high and very low socio-economic groups. The problem with this indicator is that health workers cannot be asked to visit and monitor all houses with a mud floor, mud walls and thatched roof in their areas where most of the high risk children are found, because most rural homes are built with such poor and temporary materials. But what we know is that people living in those houses are generally poor (as shown by microlevel studies referred to by Gunatilleke (1989) and also tend to have no toilet of their own or, even less likely, to have sanitary toilets. The majority of these households get their drinking water from wells or some unprotected means.

Data were obtained on certain material possessions held by the household, such as radio, refrigerator, television, tractor, car. Such possessions, however, have different

significance in different areas. Possession of a bicycle is very important in dry zone poor areas as a mode of transport but is less relevant in other areas. A refrigerator is an essential item in urban homes and some developed rural areas but is not an item normally acquired by households in rural (2) homes or in estate line-rooms. Because of this diversity in needs and characteristics, and the variations in community characteristics, such as disposal of excreta and availability of electricity, indicators taking into account the population as a whole may not be uniformly applicable to all areas of the country. Computation of such indices by different socio-economic areas is therefore desirable.

Although poverty-related characteristics and environmental exposure variables respectively are significant in the likelihood of a child being stunted and wasted, it has been argued that mere increase in income of the poor will not greatly reduce the level of undernutrition (Latham, 1987). There are several reasons for this; first, with increasing income, people exposed to a subsistence level of food intake for a long time do not necessarily spend their additional income on food. Reutlinger (1977:721) rightly points out even `educated and sophisticated consumers do not live by what they know to be nutritionally right'. Second, income increases among the poor groups normally take place very slowly. Third, as shown in an analysis of an in-depth study in Sri Lanka, there could be a certain threshold level of adult calorie consumption that must be met before there is any impact of increase in income on the calorie intake of children; Edirisinghe and Hettiarachchi (1985) compared the calorie consumption of children and adults of low and high expenditure groups, and reported that there was no significant increase in the calorie intake level of the children until 85 per cent of the standard calorie needs were reached by the adults in the family. Although undernutrition has its roots in poverty, improvements in nutrition, according to some scholars, can be achieved to some extent even without major improvements in income (Berg and Austin, 1987:446).

Malnutrition and its prevention according to one view is a responsibility of the health sector (Habicht, 1983; Chavez, 1983; Gabr, 1983). The health sector is capable

of identifying its causes and effectively controlling it. Others state that the health sector alone is unable to prevent malnutrition and any approach to prevent it should be essentially multisectoral (Garnier, 1983; Solon, 1983, Sabry, 1983). Those who believe that it is the responsibility of the health sector to combat malnutrition place high reliance on Primary Health Care (PHC) which is directed to the home rather than operated at the institutional level (Chavez, 1983).

The GOBI-FFF program of UNICEF is an important package of intervention introduced to prevent undernutrition and enhance child survival through PHC, mainly in the developing areas where infant and child mortality and the level of undernutrition are high. This program includes seven major elements: growth monitoring to measure and monitor the growth pattern of the child, oral rehydration therapy to treat diarrhoea, breastfeeding to promote infant health by providing the required nutrients to the newborn for a sufficiently long period and to maintain the health of the mother by reducing the chances of becoming pregnant soon, universal immunization covering six major diseases common in childhood, appropriate food supplementation at the appropriate time, and weaning, family planning to allow adequate space between births, and non-formal female education mainly on hygienic practices and other elements in the GOBI-FFF program. This program also covers such areas as general improvements in the status of women and the environmental sanitation (Grant, 1987:3). These, for some time, particularly since the Alma Ata declaration in 1978 (WHO, 1978b), have been the main elements of the basic services and the integrated approach of the Maternal and Child Health (MCH) programs of the countries in the developing world including Sri Lanka. GOBI-FFF, although not a panacea for child survival, gives `parents and communities a greater capacity to protect their children themselves and ultimately increases not only child survival and survival rates but the survival of the whole families' (Grant, 1987:5).

Among these approaches, growth monitoring, periodic and regular measuring and recording of weight (also of height or length), to ascertain whether the child's growth is progressing satisfactorily with age, is of central importance. If the growth

record of a child is not satisfactory, immediate action can be taken to prevent further faltering of growth and to maintain the satisfactory growth.

In Sri Lanka the prospects of implementing the GOBI-FFF elements and an effective growth monitoring program are very high, as there is a high level of contact between mothers and the health facility and a large proportion of births take place in government medical institutions. Growth monitoring is currently carried out even in remote areas of the country but the dropout rates are high. Records are kept at the peripheral health units but there is no effective system of follow-up. There are other logistic problems such as lack of health staff and funds. In order to prevent child under-nutrition, focusing only on selected elements of the GOBI-FFF program, such as growth monitoring, breastfeeding, and food supplementation may not yield the desired results. As Hubert (1987) shows, the GOBI-FFF elements have a synergistic influence and therefore it is necessary to implement the whole package of intervention; however, some doubts have been raised, mainly based on the Guatemalan field studies (Ascoli *et al.*, 1967) and Indian Narangwal study (Kielmann, Taylor and Parks, 1978), about the effectiveness of the package of health interventions on a community level (Scrimshaw, 1987).

In the estates special arrangements can be made with medical assistants and health volunteers to implement a suitable growth monitoring program with other elements in the GOBI-FFF package. In the dry zone areas, where population is sparsely distributed and travelling to and from the health facility is difficult, this program will not be successful unless the monitoring of growth and implementation of other GOBI-FFF elements move away from the clinics to the community centres.

Although the GOBI-FFF elements are mainly health sector strategies, under-nutrition is not solely a public health problem. Undernutrition is a result of economic underdevelopment and also a cause of it. In order to realize public health goals, therefore, GOBI-FFF strategies should be integrated with the development strategy of the nation.

In this respect it is worth investigating whether the strategies to prevent under-nutrition based on the GOBI-FFF elements can be integrated with the ongoing `Jana Saviya',[1] a program launched by the President of Sri Lanka to alleviate poverty. Such programs of poverty alleviation and redistribution of income and income growth are necessary to assist the poorest of the poor, who have been affected by the past changes in economic and welfare policies (discussed in Chapter 1). The details of the Jana Saviya program, its nutritional policy component and its continuity are not yet available but the program is likely to have a nutritional impact as the part of the cash payment made to the households is used to secure minimum nutritional needs.

The current procedure of selection of households to receive food stamp benefits is based on an arbitrary poverty line. What is desired is a poverty-line based on the minimum nutritional level of a household adjusted for the number and age composition of the household members. A poverty-line based on such criteria should be reviewed periodically on the basis of inflation as reflected in the consumer's price index. Borderline households should also be given due consideration. Since increasing the income of the poor requires large scale efforts that can only be effective in the long-run to protect the poor, the food stamp scheme needs to be continued.

In the implementation of the female educational element of the GOBI-FFF program, it is essential to focus more on areas such as hygienic practices, particularly in respect of food preparation; breastfeeding, weaning foods, appropriate timing of food supplementation, treatment of diarrhoea and family planning. This is very important in the estate and rural (2) areas where improper feeding appears to be responsible for the poor growth of children. In areas where safe water is a problem, special attention should also be paid to that aspect.

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1 Jana Saviya which undertook the program of poverty alleviation through assisting the poor to increase their consumption, providing opportunities to poor households, is intended to be a short-term program. Each household, mainly food stamp beneficiaries selected by further screening for their eligibility, was provided with a monthly cash payment of Rs.2500; part of which was to be used for consumption in exchange for food stamps, the other to be invested. After two years the regular investments, it is hoped, will move the household away from state assistance. The first two-year period of the Jana Saviya will be completed shortly.

Because of the family planning effect of breastfeeding as well as its nutritional benefit to the newborn, long breastfeeding is encouraged and there is evidence that in Sri Lanka the hospital and maternity home environment is in favour of breastfeeding. A report to the Bellagio conference organized by the Rockefeller Foundation, recognized that fully or near fully breastfeeding women who are not menstruating have a less than two per cent chance of becoming pregnant in the first six months (Kennedy, Rivera and McNeilly, 1989:479), and suggested that because it presents no problems of availability, accessibility or acceptability breastfeeding can be used as a natural family planning method in the first few months postpartum followed by the use of another family planning method, rather than using both simultaneously to maximize the inter-birth intervals (Kennedy *et al.*, 1989:478). Encouraging mothers to breastfeed their babies without much supplementation until the appropriate time and to continue breastfeeding with additional foods may have beneficial effects on the mother and the child. However, it should be recognized when implementing such policies that individual cases should be treated separately as the ability to breastfeed the baby without supplementation for a given duration can vary according to the individual mother and the child.

Sri Lanka has a strong family planning program provided through the large network of state health institutions with support from non-government organizations. From its very inception the program offered a wide range of ones including temporary methods such as oral pills, IUCD, Jelly, foam tablets, injections, and permanent methods of male and female sterilization. Since the 1980s the emphasis of the program has shifted to sterilization with financial incentives for the client and the health staff involved. It is important to review the effectiveness of the sterilization program and particularly its impact on the use of other modern temporary methods.

Surveys carried out in Sri Lanka in the past have consistently found a large number of couples reporting that they want to space births. For instance, among the SLDHS who were currently married (n=5442), not sterilized and wishing to have more children (n=1665), about 60 per cent reported that they wish to have the (next) baby

after two years. The majority of these women were in the 15-24 age group and also with one or two children (Department of Census and Statistics, 1988). Thus there is a prospect for the promotion of contraceptive advice, counselling and the use of efficient temporary methods. As Morley (1977) shows from the empirical evidence, an adequate interval between births will not only have the advantage of health and nutrition for the child and the mother but it also has effects on the child's intellectual development and survival.

For working women such as those in the estate sector, where nursing breaks and long periods of maternity leave are less practicable, authorities should be compelled to provide creche facilities with appropriately trained persons and breastmilk substitutes provided by the mother prepared under appropriate health and hygienic standards. In most estates, creches have been set up for the children of working mothers but the conditions prevailing and the facilities available are grossly inadequate, as revealed in the UNICEF sponsored survey (State Plantation Corporation, 1987). Since most of the large estates are run by the two state corporations, it is important that they should take the lead in providing an expansion of these facilities. It is also necessary that breastmilk substitutes or the energy dense, locally made pre-cooked food for babies are made available. This is very important in the promotion of child health particularly in the estate sector where the educational level of mothers is low and they often do not find sufficient time to prepare suitable food by themselves.

It should be emphasized that any intervention program relating to child survival in general and child undernutrition in particular in Sri Lanka should take into account the deprived population groups in the estate and rural (2) areas and these two residential areas as a whole should be taken as two vulnerable areas to receive program assistance. According to an in-depth investigation of health care behaviour and related aspects in a large plantation area in Nuwara Eliya, raised doubts about the qualification of the existing medical personnel in the estates (Caldwell, Pat, personal communication). The difficulty of attracting qualified persons to handle health and medical care services in the estates is obviously a problem but the upgrading of their skills will help reduce

health problems among the estate population.

The DHS program was nevertheless a considerable step forward in bridging the gap between the social sciences and aspects relating to health. It collected data relating a number of aspects of maternal and child health, anthropometric data for very young children together with socio-economic background data relating to the study population. However, the data collected were limited in content and detailed for a more detail study of the effects of socio-economic and behavioural characteristics on the outcome variables to be studied.

The present research relied heavily on the additional country-specific questions included on the age of introduction of various food items based on the mother's recall data. For a more detailed assessment of the nutritional status of the child population of a country, more extensive and reliable data are essential. For a thorough study of socio-economic and behavioural factors on child growth patterns comprehensive data such as maternal nutrition, birth weight, pattern of breastfeeding and food supplementation, attitudes and practices relating to breastfeeding and introduction of weaning food, different types of antenatal and postnatal care received, infant and child morbidity, immunizations and vaccinations, hygienic practices of mothers particularly in relation to feeding children, and indicators which allow one to differentiate households into broad socio-economic characteristics are required. Ideally, anthropometric data should be taken at different points of time. It is also useful to collect anthropometric data on parents, so that they can be related to the outcome variables. More importantly, they can be used to study the possible enclave effect of a deprived group in the estate sector on the anthropometry of their children. For this type of data one cannot solely rely on cross-sectional surveys and should undertake longitudinal or semi-longitudinal studies.

Ideally, such studies should follow a cohort of women from their pregnancy, through delivery and at least until the child completes its pre-school age. The data collection should be made at regular but short intervals to minimize errors in the data. Launching such studies even on a semi-longitudinal basis may be impracticable on

fairly large samples (such as the Infant Mortality Study carried out under the monitoring project for Child Survival and Development launched in the dry zone of Sri Lanka) because of resource constraints and operational problems. These can be done on a small sample including people from different socio-economic backgrounds, such as urban, rural (1), rural (2) and estates, and certain ethnic groups such as Sri Lankan Tamils and Moors. The problem with such studies is the high drop-out rates due to the mobility of people; some move temporarily while others are lost to follow-up, most permanently. But if longitudinal data are obtained scientifically, they can be a very useful tool in evaluating and monitoring nutritional and surveillance and survival programs. If this approach is combined with regular monthly measurements of anthropometric data, then it will give very valuable information on growth velocities which can be used to assess the impact of different proximate variables on growth. More importantly velocity data will give a clearer picture about the age pattern of linear growth.

Before concluding it is important to draw attention to an issue raised in this study; co-existence of low mortality with high levels of undernutrition. While reviewing evidence on link between malnutrition and child mortality, Martorell and Sharma (1985:200) listed the following possible mechanisms. Malnutrition lowers the defence system of the body against infections; children are frequently sick as they live in unhealthy environments and mortality rates from diseases such as measles are higher among the malnourished.

In all these cases the effects are stronger for the severely undernourished than moderately or mildly undernourished. Studies conducted in other parts of the world discussed earlier in chapters 1 and 3 showed that the risk of death is usually higher among the children whose nutritional status (based on anthropometric criteria) falls much below that of the reference population. For instance, Chen and others (1980) demonstrated a threshold nutritional level of below 85 per cent of the reference median as a greatly elevated risk of dying in the following two years. In Sri Lanka, as seen above, the majority of the children affected are in fact mildly to moderately

undernourished and the proportion of children who are severely undernourished is comparatively small. Although the physical growth and development of the undernourished children are in general poor, and the undernourished children are more likely to be subject to infections, the severity and duration of infections are determined by their nutritional status (Black, Brown and Becker, 1984).

In Sri Lanka, the state welfare policies discussed in Chapter 1, particularly the investments in health and education have tended to avert deaths at an early age. Mortality rates in Sri Lanka, particularly infant and child mortality are very low, for the country as a whole as a result of developed health care system, high literacy level of the population and improved awareness health. As a result current level of undernutrition does not necessarily pose a serious threat to survival as has been observed in some developing countries.

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Appendix Tables for Chapter 4

Table A.4.1 Per cent Distribution of Socio-economic Characteristics of Study Population by Socio-economic Zone

Characteristic	Zone 1	Zone2	Zone3	Zone4	Zone5	Zone6	Zone 7
Level of education of mother	***						
No schooling	3.4	1.1	4.6	6.8	18.7	8.1	11.6
Primary	19.2	18.4	32.2	31.9	28.9	26.7	38.1
Secondary	44.6	50.7	30.6	34.6	32.1	38.6	34.1
Higher	32.8	29.8	32.6	26.7	20.3	26.6	16.2
Level of education of father* **							
No schooling	3.4	4.8	6.7	7.8	9.2	4.3	7.6
Primary	12.4	11.0	28.4	27.4	34.8	31.0	33.9
Secondary	41.8	47.8	37.2	36.5	33.5	41.8	39.7
Higher	42.4	36.4	27.7	28.3	22.5	22.9	18.8
Level of education of parents	***						
Both primary or less	11.3	9.2	20.5	23.4	33.7	21.0	29.2
One secondary other lower	14.7	16.2	22.6	22.5	20.9	23.8	28.2
Both secondary	26.0	30.1	16.7	16.3	15.9	20.0	17.2
One higher than secondary and other lower	20.9	22.8	20.1	20.5	16.3	21.0	15.8
Both higher than secondary	27.1	21.7	20.1	17.3	13.2	14.3	9.6
Occupation of mother	***						
Not working	87.6	90.8	73.5	90.9	70.9	94.8	94.4
Agricultural Occupation	0.6	-	11.0	2.9	23.4	0.5	1.7
Other Occupation	11.9	9.2	15.5	6.2	5.7	4.8	4.0
Occupation of Father	***						
Administrative, technical, clerical and related work	24.3	18.4	14.7	10.1	10.9	9.5	7.9
Other formal sector employment	28.2	20.6	20.1	18.5	9.6	11.8	11.5
Skilled Work	23.7	31.6	21.3	16.9	10.0	13.3	12.6
Unskilled Work	23.2	25.0	28.4	16.3	19.7	12.8	12.9
Agricultural Work	0.6	4.4	15.5	38.1	49.8	52.5	55.1

Table A.4.1 (cont'd)

Characteristic	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Materials of construction of:							
(a) **Wall** ***							
Brick	71.8	67.3	60.8	49.1	62.4	45.6	24.1
Mud	28.2	32.7	39.2	50.9	37.6	54.4	75.9
(b) **Floor** ***							
Cement	92.1	74.3	64.5	48.8	43.4	48.6	36.7
Mud	7.9	25.7	35.5	51.1	56.6	54.4	63.3
(c) **Roof** ***							
Tiled/Asbestos	69.5	61.0	66.5	52.8	36.3	45.2	28.5
Thatched/Zinc sheets or waste materials	30.5	39.0	33.5	47.2	63.7	54.8	71.5
Source of drinking water* **							
Pipe	41.8	5.1	5.9	3.6	9.9	5.2	0.7
Public tap/tube well	27.7	0.4	2.5	5.2	23.5	16.1	9.9
Protected well	25.4	66.9	44.3	45.9	22.2	43.9	48.7
Unprotected well	5.1	26.5	41.4	32.6	29.2	28.6	34.1
River/stream, tank etc	-	1.1	5.9	15.2	13.2	6.2	6.6
Toilet facilities ***							
None	2.3	7.4	12.1	18.6	23.2	17.7	48.1
Sanitary	87.6	53.6	45.7	34.2	28.9	31.4	15.5
Other Toilet:							
Exclusive Use	4.5	29.1	37.6	42.1	41.2	47.6	35.1
Shared Use	5.6	9.9	4.6	5.1	6.7	3.3	1.3

*** Significant at $p < 0.001$

Table A.4.2 Health Care Behaviours of Pregnant Women and Patterns of Vaccination/Immunization of New Borns by Socio-Economic Zone

Characteristic	Zone 1	Zone 2	Zone 3	Zone4	Zone5	Zone	Zone7
Number of pregnancies children (weighted)	**146**	**259**	**291**	**437**	**451**	**145**	**264**
Ante-natal care							
Whether tetanus toxoid given? (ns)							
Given	87.6	84.9	85.3	87.9	83.4	85.5	85.1
Not given	12.4	15.1	14.7	12.1	16.6	14.5	14.9
Whether seen by a doctor* **							
Yes	97.6	97.0	97.6	97.8	96.3	94.9	90.7
No	2.4	3.0	2.4	2.2	3.7	5.1	9.3
Whether visited by a Family Health worker (FHW)* **							
Yes	49.4	78.4	71.4	69.5	64.9	55.3	57.5
No	50.6	21.6	28.6	30.5	41.8	44.7	42.5
Source of ante-natal care received ***							
Visited by a FHW and visited a Doctor/clinic	48.2	76.1	70.2	67.9	63.2	54.5	54.9
FHW only	1.2	2.3	1.2	1.5	1.7	0.9	2.7
Doctor only	49.4	20.8	27.4	29.9	33.1	40.4	35.8
Neither FHW nor a Doctor	1.2	0.8	1.2	0.6	2.0	4.3	6.6
Care during delivery Place of birth ***							
Institution	78.2	93.9	88.8	87.7	77.0	87.6	74.8
Other	21.8	6.1	11.2	12.3	23.0	12.4	25.2
Person assisting delivery* **							
Medical	98.2	94.7	92.0	90.7	80.4	87.6	74.9
TBA	1.8	4.9	4.4	6.5	8.4	9.0	11.2
Other person/No assistance	-	0.4	3.5	2.8	11.2	3.4	13.9
Vaccination/Immunisation B.C.G. ***							
Given	79.4	83.7	84.9	87.7	68.5	87.7	74.2
Not given	20.6	16.3	15.1	12.3	31.5	12.3	25.8
For children aged 12-36 months (N=1482)							
DPT vaccination Dose 3 ***							
Given	69.8	79.4	75.7	85.0	72.0	83.6	66.7
Not given	30.2	20.6	24.3	15.0	28.0	16.4	33.3
Polio vaccination Dose 3* **							
Given	69.8	79.4	75.1	84.6	72.0	83.6	66.7
Not given	30.2	20.6	24.9	15.4	28.0	16.4	33.3
Measles vaccination ***							
Given	46.8	62.4	49.7	62.5	50.4	60.5	53.9
Not given	53.2	37.6	50.3	37.5	49.6	39.5	46.1

ns= Not significant *** significant at $p < 0.001$

Appendix Tables for Chapter 5

Table A.5.1 Percentage of children undernourished according to whether a product of single or multiple confinements by indicators of undernutrition.

Nutritional indicator	All	Singletons	Multiple births
Number of children	1993	1966	27
Length for age**	37.4	27.1	46.6
Weight for length	11.6	11.5	85.5
Weight for age	37.4	37.2	62.8

Note: for each of the indicators, children below -2.00 standard deviation units from the WHO/NCHS have been considered under-nourished.

** significant at $p < .0.01$.

Appendix A.5.2

A brief description on Sri Lanka Nutrition Survey of 1975/76 and the survey program of the Food and Nutrition Policy Planning Division a comment on the comaparability of results

Sri Lanka Nutrition Status Survey of 1975-76

The Sri Lanka Nutrition Survey (SLNSS) was the first of the more comprehensive surveys carried out in Sri Lanka when the nutrition became the subject of much discussion since the food crisis of 1974.

The objectives of the SLNSS were:

(i) to provide reliable estimates of undernutrition among preschool children in Sri Lanka according to the Superintendent of Health Services (SHS) areas, on the basis of data collected on weight and height of preschool children, anaemia and vitamin A deficiency.

(ii) the data thus collected to serve as a baseline and to be used for planning for nutritional interventions and to monitor the changes in the nutritional status of the country, and

(iii) to develop the survey capabilities of the Ministry of Health to carry out independent research of this nature.

For the purpose of the survey a total of 450 clusters were selected from the 15 SHS areas based on the 1971 population census register of census blocks (enumerator areas). The number of clusters to be selected from each SHS area was predetermined to be 30; from each of the 30 clusters 30 children were targeted for the survey. The first household to be covered was selected randomly and 30 children aged 6-72 months were selected from around the first household.

Among the anthropometric measurements, weight, length and arm circumference were collected. Length was measured to the nearest centimetre using a

portable wooden board while weight was measured using a Salter hanging scale and the values were recorded to the nearest 0.1 kg. Arm circumference was measured with a Zerfas slotted tape. Blood samples were taken, to assess anaemia prevalence, and data were collected, on Bitot's spots, corneal scars and night blindness from a sample of children to estimate the prevalence of vitamin A deficiency.

The field work of the survey was carried out during September 1975 - March 1976, by 24 persons, of whom the majority were Pulic Health Inspectors of the Ministry of Health. The survey report (DEHW, 1976) shows that in addition to the vigorous training program and supervision exercised in the survey, several standardization tests were conducted to assess the performance of the survey team in measuring and recording anthropometric maesurements.

In addition to the data on anthropometric measurements, other information relating to vitamin A deficiency and anaemia, and date of birth of the child, birth order of the child and stated income level of the household were also collected. No data were however collected in respect of other socio-economic and environmental characteristics of the population. A report has been published highlighting the details of the survey methodology and procedures, and the results of the survey (DEHW, 1976); a further analysis of the prevalence of Vitamin A deficiency has also been done (Brink *et al.*, 1979).

Surveys of the Food and Nutrition Policy Planning Division

In 1978 a special unit, Food and Nutrition Policy Planning (FNPPD) was created within the Ministry of Plan Implementation under the President to frame policy pertaining to nutrition in Sri Lanka and to review the decisions taken by the government affecting food policy. This division initiated several research studies relating to food policy and conducted sample surveys to assess the prevalence of undernutrition and its socio-economic determinants.

Initially, the Medical Research Institute (MRI) of the Ministry of Health

conducted in 1979 a nutritional status survey of preschool children, under the nutritional surveillance program, on the lines of the SLNSS of 1975-76. The survey was, however, confined to two districts in the Southern part of the Sri Lanka, Matara and Hambantota. As in the 1975-76 survey, preschool children in the 6-72 months of age, were covered. The survey in these two districts was conducted more as a pilot project, and hence no proper sampling design was developed.

With the creation of FNPPD, it was decided to extend the surveys to six more districs (Puttalam, Kurunegala, Vavuniya, Matale, Moneragala, and Nuwara Eliya) and a new agriculture settlement area (Mahaveli). These were earmarked for development programs. The procedures used for the selection of samples has not been stated but it appears to have been done in two stages: initially 10 per cent of villages in each district were selected randomly from the village lists maintained at the Department of Census and Statistics, and then household lists were prepared for these villages. From them 10 per cent of the households with at least one child in the 6-72 months age group were selected for the survey. The weight and height meesurements were taken by the Public Health Inspectors who had participated in the 1975-76 survey. These surveys covered a preschool population (6-72 months old) in the urban, rural and estate sectors. Although it was originally intended to go by SHS divisions to enable direct comparison with the SLNSS of 1975, the survey was carried out on the basis of civil administrative districts (at that time there were 24 civil administrative districts and 16 SHS divisions in the country).

Next, with additional funding and other resources, the survey work was extended to the rest of the districts. This was done during 1981-82. For the survey 10 per cent of the 1981 census blocks in each district stratified by urban, rural, and estate sectors were selected randomly in the first stage. The selection of census blocks was done according to the Probability Proportional to the Population Size. From each of the selected blocks 10 households were selected. The intention was to cover cover six households with at least one preschool child in each census block. With the reduction of the minimum school-going age from 6 to 5 years, the population targeted for the

survey was also reduced (A. Kahanda, personal communication). As a result for these districts survey data are available for children aged 6-60 months. While the survey was continuing in the field it was found that the targeted number of households with a preschool child was difficult to find in the randomly selected 10 households. Thus the process of selection of the households was changed; from the first household selected in a census block all households were visited until the target number of households was covered. As the fieldwork took longer than expected this required minimum was not strictly adhered to.

In addition to the data collected on weight and length of children the survey focused more on the economic aspects of the households (consumption, expenditure and income) but very little attention was paid to the demographic factors, or to data on breastfeeding and feeding practices which are also important in understanding the variations in nutritional status of population groups. There is no doubt that the quality of income data collected at the FNPPD survey may have suffered to a large extent not only because they are hard to obtain but because they were gathered at a time of welfare and food policy based on the stated household income, which was undergoing changes.

The survey data have been analyzed and a preliminary report highlighting the estimates of undernutrition by districts was incorporated in a publication of the FNPPD in 1981. The report however did not give details of the methodologies or the procedures adopted in weighing and measuring children or any other details of field work but alerted the readers to the possibility of problems in comparing the results of the eight district surveys with those of SLNSS of 1975:

> The differences of the geographical boundaries of the sample areas [1979 and 1980 surveys used districts whereas 1975-76 survey used SHS divisions] as well as the differences in the sampling methodology preclude such comparisons. This point must be clearly grasped and borne in mind (FNPPD, 1981:1).

Later, when the survey work in the rest of the administrative districts was completed, prevalence estimates were made for the Sri Lanka as a whole and by administrative districts; data available refer to the 1980-82 survey, presumably ignoring

the data collected in the first two districts, Matara and Hambantota, in 1979.

Apart from the differences in the sampling procedures adopted between the two surveys (SLNSS 1975-76 and FNPPD surveys 1980/82) the SLNSS covered only the rural and estate sectors of the country leaving out the urban sector. The estate areas were however not treated as a separate sampling entity. In the FNPPD surveys all the three sectors were covered but in the districts surveyed in 1980 the population covered in each of the sectors did not agree with the population distribution between the sectors within the districts. In the case of SLDHS 1987, sampling was done on the basis of socio-economic zones and the sample was stratified by urban, rural and estate sectors. Two zones, 8 and 9, were, however not covered.

The time taken to complete the field work in the three surveys also raises problems of comparability of data. The SLNSS and SLDHS surveys were conducted in a fairly short time: the FNPPD surveys took about three years (ignoring the two districts completed in 1979) for the field work to be concluded. This invariably included dry and wet seasons or the *yala* and *maha* (two agricultural seasons a year). These may influence the general food intake, and prevalence of diarrhoea and infections, which have differential impacts on the nutritional status of children. Usually the pre-harvest period is characterized by food shortages mainly among adults, and infective diseases affecting the growth of children. Similarly, extending the survey work for three years also has its effect on nutritional status as it covered several school seasons and holidays. In general the nutritional level, particularly weight, is better among children during school seasons than in holidays because of the school feeding programs and improved activity level of the children. The survey work of the FNPPD survey in fact coincided with the period of welfare and food policy changes which was introduced in several stages. Thus, the nutritional level of the population groups directly affected by these changes may have been represented in the survey differently according to the changes taking place at the time of the survey.

Besides these there may have been effects on data quality as well; it has been

observed that the performance of measurers or the precision and accuracy of the measurements tend to change while the field work is progressing. Some tend to improve their precision and accuracy while others get worse. This was clearly observed among the SLDHS measurers, when the results of standardization tests conducted at the beginning and midway through field work were compared. It is hard, without the data on such tests conducted, from time to time, to assess the extent of measurement errors, if any, when the survey field work extended for about three years. What can normally be expected is that these biases will be strong and the general enthusiasm of the measurers may have deteriorated during the long period of field work.

FNPPD after processing the data preliminary tables on different characteristics of the study population was produced and compared them with that of the 1981 Socio-economic Survey of the Department of Census and Statistics. Despite the data problems anticipated, a close correspondence was found betweeen them. On the basis of these estimates of various socio-economic characteristics FNPPD concluded that the survey data were reasonably satisfactory for the estimation of undernutrition prevalence and comparison with relevant age groups and residential sectors (Amarasekere, 1983:45-46).

Table A.5.3 Sex differentials in stunting and wasting among children aged 3-36 months old by selected socio-economic characteristics

Characteristic	Prevalence of `Stunting'		Prevalence of `Wasting'		Number	
	Boys	Girls	Boys	Girls	Boys	Girls
All						
Residential area						
Urban	21.6	16.4	12.2	8.3	135	125
Rural (1)	22.8	27.5	11.2	11.9	715	605
Rural (2)	31.3	28.6	14.7	17.1	131	123
Estate	59.0	60.9	6.1	3.6	67	63
Level of education of mother						
No schooling	44.1	58.0	10.9	8.5	104	73
Primary	32.9	34.6	12.0	13.7	297	267
Secondary	22.2	27.4	12.6	11.4	388	342
Higher	16.5	13.6	9.3	10.2	261	233
Religion of mother						
Buddhists	24.3	26.9	12.2	12.9	876	745
Hindus	54.5	56.4	4.1	2.2	62	61
Moslems	18.2	17.7	6.3	8.8	56	51
Other	29.3	28.2	13.3	6.2	56	58

Table A.5.4 Average daily calorie consumption paer adult equivalency unit (AEU) by expenditure group and sector

Expenditure deciles*	Average Calorie Consumed AEU			
	Urban	Rural	Estate	All
1	1477	1613	1564	1587
2	1853	2076	2088	2047
3	2099	2309	2322	228
4	2282	2525	2717	2525
5	2375	2696	2864	2661
6	2375	2696	2864	2661
7	2678	3211	3227	3124
8	2816	3339	3925	3286
9	3082	3765	4269	3627
10	3372	4228	4104	3877
All	2629	2807	2994	2791

Source:Shan (1984):7, Table 2.

Table A.5.5 Average daily protein consumption par adult equivalency unit (AEU) by expenditure group and sector

Expenditure deciles*	Average protein (gms) Consumed AEU			
	Urban	Rural	Estate	All
1	34.7	34.9	37.3	35.1
2	44.2	46.3	49.9	45.4
3	50.9	52.2	52.4	52.0
4	56.1	57.8	65.7	58.9
5	59.5	61.9	68.0	62.2
6	63.2	66.7	78.2	67.4
7	67.6	75.8	74.8	74.3
8	72.6	78.5	54.1	78.8
9	78.9	90.3	104.3	88.9
10	90.0	103.4	103.5	97.9
All	67.0	65.0	71.0	66.1

Source: Shan (1984):8, Table 3.

Appendix 6

Appendix A.6.1

SECTION 4: HEALTH OF CHILDREN

401 CHECK 214: HAD BIRTH SINCE JAN. 1982 ☐ | NO BIRTH SINCE JAN. 1982 ☐ (SKIP TO 501)

402 FROM QUESTION 212 ON P. 10, RECORD THE NAMES AND LINE NUMBERS OF ALL BIRTHS SINCE JAN. 1982 IN THE FOLLOWING TABLE. FOR EACH BIRTH, CHECK IF ALIVE OR DEAD, AND MARK THE APPROPRIATE BOX.

ASK QUESTIONS 403-422 FOR ALL BIRTHS, ALIVE AND DEAD	LAST BIRTH ☐☐ (name and line number) ALIVE ☐ DEAD ☐	NEXT-TO-LAST BIRTH ☐☐ (name and line number) ALIVE ☐ DEAD ☐	SECOND-TO-LAST BIRTH ☐☐ (name and line number) ALIVE ☐ DEAD ☐
403 Did you receive a tetanus injection when you were pregnant with (NAME)?	YES, 1 DOSE......1 YES, 2 DOSES.....2 NO..............3 DOES NOT KNOW....4	YES, 1 DOSE......1 YES, 2 DOSES.....2 NO..............3 DOES NOT KNOW....4	YES, 1 DOSE......1 YES, 2 DOSES.....2 NO..............3 DOES NOT KNOW....4
404 Did the Family Health midwife visit you when you were pregnant with (NAME)?	YES..............1 NO...............2	YES..............1 NO...............2	YES..............1 NO...............2
405 Did you visit a doctor or a clinic for a check on this pregnancy?	YES..............1 NO...............2	YES..............1 NO...............2	YES..............1 NO...............2
406 In what type of place was (NAME) born?	GOVT HOSP/MATERNITY HOME......1 PRIV NURSING HM..2 AT HOME..........3 OTHER________.4 (specify)	GOVT HOSP/MATERNITY HOME......1 PRIV NURSING HM..2 AT HOME..........3 OTHER________.4 (specify)	GOVT HOSP/MATERNITY HOME......1 PRIV NURSING HM..2 AT HOME..........3 OTHER________.4 (specify)
407 Who assisted with the delivery of (NAME)? PROBE AND RECORD MOST QUALIFIED PERSON.	DOCTOR...........1 GOVT NURSE/ MIDWIFE........2 TRADITIONAL BIRTH ATTENDANT......3 REL/NEIGHBOR.....4 OTHER________5 (specify) NO ONE...........6	DOCTOR...........1 GOVT NURSE/ MIDWIFE........2 TRADITIONAL BIRTH ATTENDANT......3 REL/NEIGHBOR.....4 OTHER________5 (specify) NO ONE...........6	DOCTOR...........1 GOVT NURSE/ MIDWIFE........2 TRADITIONAL BIRTH ATTENDANT......3 REL/NEIGHBOR.....4 OTHER________5 (specify) NO ONE...........6
408 Did you ever feed (NAME) at the breast?	YES............ 1 NO............. 2 (SKIP TO 414)	YES............ 1 NO............. 2 (SKIP TO 414)	YES............ 1 NO............. 2 (SKIP TO 414)

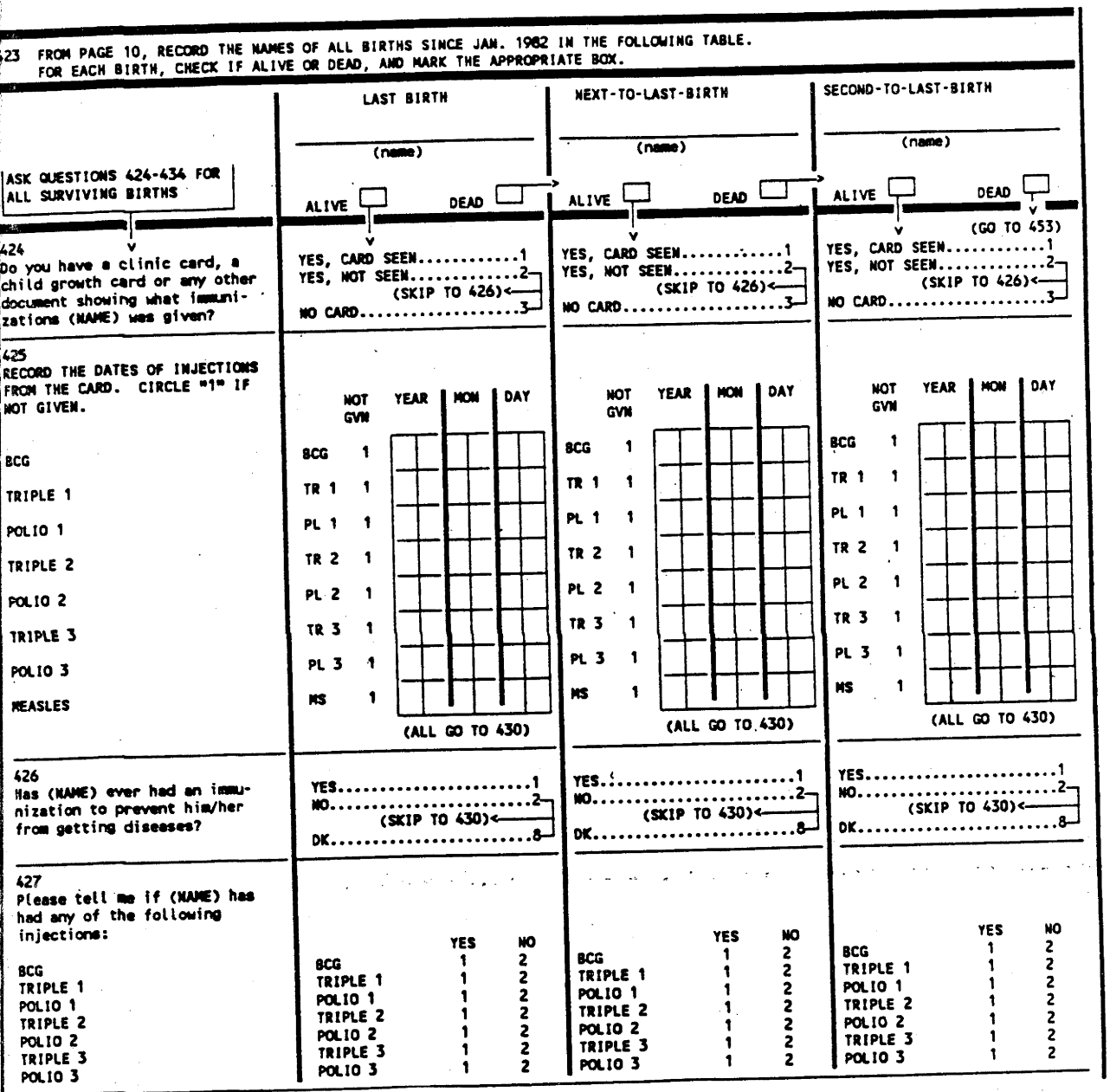
Appendix A.6.1 (cont'd)

409 How many days after birth did you begin feeding (NAME) at the breast?	SAME DAY.........1 NEXT DAY.........2 TWO DAYS AFTER...3 THREE + DAYS.....4	SAME DAY.........1 NEXT DAY.........2 TWO DAYS AFTER...3 THREE + DAYS.....4	SAME DAY.........1 NEXT DAY.........2 TWO DAYS AFTER...3 THREE + DAYS.....4
410 Was the colostrum (the first milk produced) given to (NAME) or was it thrown away?	FED TO BABY......1 (SKIP TO 412) THROWN AWAY......2	FED TO BABY......1 (SKIP TO 413) THROWN AWAY......2	FED TO BABY......1 (SKIP TO 413) THROWN AWAY......2
411 Why did you throw it away?	MILK BAD FOR BABY............1 MILK YELLOW......2 BABY REFUSED.....3 HABIT............4	MILK BAD FOR BABY............1 MILK YELLOW......2 BABY REFUSED.....3 HABIT............4	MILK BAD FOR BABY............1 MILK YELLOW......2 BABY REFUSED.....3 HABIT............4
412 Are you still breastfeeding (NAME)? IF DEAD, CIRCLE '3'.	YES............ 1 (SKIP TO 415) NO..............2 CHILD DEAD 3		
413 At what age did you totally stop breastfeeding (NAME)?	MONTHS.... [ ][ ] AT DEATH.......96 (SKIP TO 415)	MONTHS.... [ ][ ] AT DEATH.......96 (SKIP TO 415)	MONTHS.... [ ][ ] AT DEATH.......96 (SKIP TO 415)
414 What is the main reason you (never breastfed/stopped breastfeeding) (NAME)?	NO MILK.........01 INSUFFICNT MILK.02 NIPPLE INJURED..03 MOTHER ILL......04 MOTHER BUSY.....05 OTHER MILK/FOOD BTR FOR BABY...06 BABY ILL........07 BABY REFUSED....08 OTHER_________.09 (specify) BECAME PREGNANT.10 BABY DIED RIGHT AFTER BIRTH....11 (SKIP TO 420)	NO MILK.........01 INSUFFICNT MILK.02 NIPPLE INJURED..03 MOTHER ILL......04 MOTHER BUSY.....05 OTHER MILK/FOOD BTR FOR BABY...06 BABY ILL........07 BABY REFUSED....08 OTHER_________.09 (specify) BECAME PREGNANT.10 BABY DIED RIGHT AFTER BIRTH....11 (SKIP TO 420)	NO MILK.........01 INSUFFICNT MILK.02 NIPPLE INJURED..03 MOTHER ILL......04 MOTHER BUSY.....05 OTHER MILK/FOOD BTR FOR BABY...06 BABY ILL........07 BABY REFUSED....08 OTHER_________.09 (specify) BECAME PREGNANT.10 BABY DIED RIGHT AFTER BIRTH....11 (SKIP TO 420)

Appendix A.6.1 (cont'd)

at age did you begin to the following foods to ?? READ OUT CATEGORIES. dered milk: half cream dered milk: full cream /goat milk gee s hed potatoes/cereal it/juice/soup GIVEN IN FIRST MONTH NEVER GIVEN DK	MONTHS HALF CREAM FULL CREAM COW MILK CUNGEE EGGS POTATOES FRUIT	MONTHS HALF CREAM FULL CREAM COW MILK CUNGEE EGGS POTATOES FRUIT	MONTHS HALF CREAM FULL CREAM COW MILK CUNGEE EGGS POTATOES FRUIT
hat age did you start at one food on a daily s?	MONTHS	MONTHS	MONTHS
K 416:	6 MONTHS OR LESS (SKIP TO 419) 7 MONTHS OR MORE	6 MONTHS OR LESS (SKIP TO 419) 7 MONTHS OR MORE	6 MONTHS OR LESS (SKIP TO 419) 7 MONTHS OR MORE
did you wait so long to n daily supplemental ing of (NAME)?			
you began daily supple- al feeding of (NAME), did continue full breastfeed- did you reduce; or did stop completely?	CONTINUED FULL...1 REDUCED.....2 STOPPED.....3 NEVER B'FED.....4	CONTINUED FULL...1 REDUCED.....2 STOPPED.....3 NEVER B'FED.....4	CONTINUED FULL...1 REDUCED.....2 STOPPED.....3 NEVER B'FED.....4
many months after the h of (NAME) did your od return?	MONTHS.... NOT RETURNED...96	MONTHS.... NEVER RETURNED..96	MONTHS.... NEVER RETURNED..96
you resumed sexual re- ions since the birth of E)?	YES (OR PREG)...1 NO..... 2 (GO TO NEXT COL)		
many months after the h of (NAME) did you me sexual relations?	MONTHS.... (GO BACK TO P. 24 ASK 403 NEXT BIRTH)	MONTHS.... (GO BACK TO P. 24 ASK 403 NEXT BIRTH)	MONTHS.... (ALL GO TO 423)

Appendix A.6.1 (cont'd)



423 FROM PAGE 10, RECORD THE NAMES OF ALL BIRTHS SINCE JAN. 1982 IN THE FOLLOWING TABLE. FOR EACH BIRTH, CHECK IF ALIVE OR DEAD, AND MARK THE APPROPRIATE BOX.

	LAST BIRTH	NEXT-TO-LAST-BIRTH	SECOND-TO-LAST-BIRTH
	(name)	(name)	(name)
ASK QUESTIONS 424-434 FOR ALL SURVIVING BIRTHS	ALIVE ☐ DEAD ☐ →	ALIVE ☐ DEAD ☐ →	ALIVE ☐ DEAD ☐ (GO TO 453)
424 Do you have a clinic card, a child growth card or any other document showing what immunizations (NAME) was given?	YES, CARD SEEN.....1 YES, NOT SEEN.....2 (SKIP TO 426) NO CARD.....3	YES, CARD SEEN.....1 YES, NOT SEEN.....2 (SKIP TO 426) NO CARD.....3	YES, CARD SEEN.....1 YES, NOT SEEN.....2 (SKIP TO 426) NO CARD.....3
425 RECORD THE DATES OF INJECTIONS FROM THE CARD. CIRCLE "1" IF NOT GIVEN.	NOT GVN / YEAR / MON / DAY	NOT GVN / YEAR / MON / DAY	NOT GVN / YEAR / MON / DAY
BCG	BCG 1	BCG 1	BCG 1
TRIPLE 1	TR 1 1	TR 1 1	TR 1 1
POLIO 1	PL 1 1	PL 1 1	PL 1 1
TRIPLE 2	TR 2 1	TR 2 1	TR 2 1
POLIO 2	PL 2 1	PL 2 1	PL 2 1
TRIPLE 3	TR 3 1	TR 3 1	TR 3 1
POLIO 3	PL 3 1	PL 3 1	PL 3 1
MEASLES	MS 1	MS 1	MS 1
	(ALL GO TO 430)	(ALL GO TO 430)	(ALL GO TO 430)
426 Has (NAME) ever had an immunization to prevent him/her from getting diseases?	YES.....1 NO.....2 (SKIP TO 430) DK.....8	YES.....1 NO.....2 (SKIP TO 430) DK.....8	YES.....1 NO.....2 (SKIP TO 430) DK.....8
427 Please tell me if (NAME) has had any of the following injections:	YES / NO	YES / NO	YES / NO
BCG	BCG 1 2	BCG 1 2	BCG 1 2
TRIPLE 1	TRIPLE 1 1 2	TRIPLE 1 1 2	TRIPLE 1 1 2
POLIO 1	POLIO 1 1 2	POLIO 1 1 2	POLIO 1 1 2
TRIPLE 2	TRIPLE 2 1 2	TRIPLE 2 1 2	TRIPLE 2 1 2
POLIO 2	POLIO 2 1 2	POLIO 2 1 2	POLIO 2 1 2
TRIPLE 3	TRIPLE 3 1 2	TRIPLE 3 1 2	TRIPLE 3 1 2
POLIO 3	POLIO 3 1 2	POLIO 3 1 2	POLIO 3 1 2

Appendix A.6.1 (cont'd)

hat age age was (NAME) given last of tof these immuni- ons?	MONTHS....	MONTHS....	MONTHS....
(NAME) gi) given e measles ine?	YES.....1 NO.....2	YES.....1 NO.....2	YES.....1 NO.....2
(NAME) hi) had diarrhea in the 24 hoursours?	YES..... 1 (SKIP TO 432) NO.....2	YES..... 1 (SKIP TO 432) NO.....2	YES..... 1 (SKIP TO 432) NO.....2
(NAME) hi) had diarrhea in the two weekweeks?	YES..... 1 NO..... 2 (GO TO NEXT COL) DK.....8	YES..... 1 NO..... 2 (GO TO NEXT COL) DK.....8	YES..... 1 NO..... 2 (GO TO 435) DK.....8
ou take ake (NAME) to a gov- nt hospiospital or clinic, Western ern doctor, or to an etic doc doctor to treat the hea (the(the last time)? IF Where dre did you take er?	YES, GOVT HOSP/CLIN..1 YES, WESTERN DR.....2 YES, AYURVETIC DR....3 NO, NOT TAKEN.....9	YES, GOVT HOSP/CLIN..1 YES, WESTERN DR.....2 YES, AYURVETIC DR....3 NO, NOT TAKEN.....9	YES, GOVT HOSP/CLIN..1 YES, WESTERN DR.....2 YES, AYURVETIC DR....3 NO, NOT TAKEN.....9
(NAME) gi) given any packet evanee oee or UNICEF salts eat the the diarrhea (the time)?)?	YES.....1 NO..... 2 DK.....8	YES.....1 NO..... 2 DK.....8	YES.....1 NO..... 2 DK.....8
here any anything (else) you mebody dly did to treat the hea? IF IF YES: What was E CODE 1)E 1 FOR ALL OMED. .	HOME SUGAR/SALT/ WATER SOLUTION..1 TABLETS/INJEC- TIONS,SYRUPS....1 INCREASE FLUIDS..1 INCREASE FOODS...1 GIVE CUNJEE.....1 DECREASE FLUIDS..1 DECREASE FOODS...1 OTHER_____.1 (specify) NOTHING.....1 (ALL GO TO NEXT COL)	HOME SUGAR/SALT/ WATER SOLUTION..1 TABLETS/INJEC- TIONS,SYRUPS....1 INCREASE FLUIDS..1 INCREASE FOODS...1 GIVE CUNJEE.....1 DECREASE FLUIDS..1 DECREASE FOODS...1 OTHER_____.1 (specify) NOTHING.....1 (ALL GO TO NEXT COL)	HOME SUGAR/SALT/ WATER SOLUTION..1 TABLETS/INJEC- TIONS,SYRUPS....1 INCREASE FLUIDS..1 INCREASE FOODS...1 GIVE CUNJEE.....1 DECREASE FLUIDS..1 DECREASE FOODS...1 OTHER_____.1 (specify) NOTHING.....1 (ALL GO TO 435)

Appendix A.6.1 (cont'd)

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP TO
435	CHECK 433: "1" MARKED FOR ANY BIRTH? IF 433 IS EMPTY, MARK "NO". NO ☐ YES ☐		>439
436	Have you ever heard of JEEVANEE or UNICEF Salts which you can give to a child with diarrhea?	JEEVANEE.....1 UNICEF.....2 BOTH.....3 NEITHER.....4	>438
437	INTERVIEWER: SHOW JEEVANEE AND UNICEF PACKETS. ASK: Have you ever seen either or both packets before?	JEEVANEE.....1 UNICEF.....2 BOTH.....3 NEITHER.....4	>446
438	Have you ever given either JEEVANEE or UNICEF Salts to any of your children?	YES.....1 NO.....2	>446
439	Where did you obtain the packet (the last time)?	GOVT HOSP/CLIN.....1 MOH OFFICE.....2 PHARMACY.....3 PRIV. DOCTOR.....4 OTHER_____.5 (specify)	
440	How much did one packet cost? IF FREE, ENTER RS.00.00.	COST....Rs. ☐☐.☐☐ DK.....9998	
441	I now have some questions about how to prepare Jeevanee.		
442	Please describe the type of water used to mix Jeevanee.	PLAIN WATER.....1 BOILED AND COOLED.....2 OTHER/DK.....3	
443	Describe how the powder is mixed.	1 PACKET IN 1 LITER OF WATER.....1 OTHER/DK.....2	>445
444	How do you measure the water?	1 LITER VESSEL.....1 2.5 BOTTLES SODA WATER...2 1 1/3 BOTTLES ARRACK.....3 5 TEA CUPS.....4 OTHER/DK.....5	

Appendix A.6.1 (cont'd)

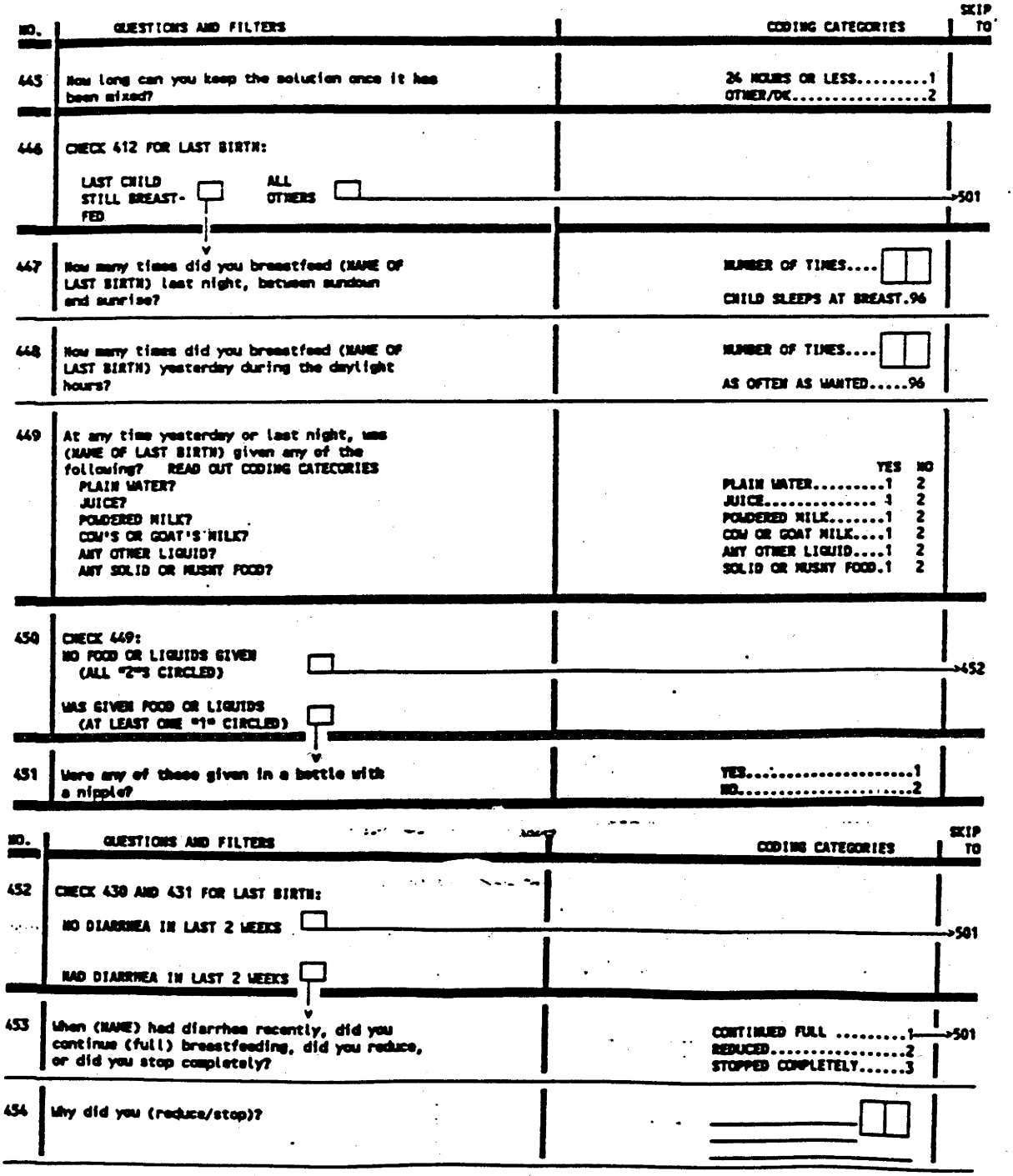


Table A.6.2 Level of statistical significance of the differences in the breastfeeding durations between the pairs of subgroups derived from D statistics.

Characteristic	Comparison subgroup	Level of significance
Maternal fertility factors:		
Sex of child	Boy vs girl	*
Maternal age	All groups	ns*
Birth order:	1 vs 2; 1 vs 3; 1 vs 5	***
	1 vs 4, 3 vs 5; 4 vs 5	**
	other pairs	ns
(b) Socio-economic characteristics		
Place of current residence	urban vs rural (1)	***
	urban vs rural (2)	***
	urban vs estate	***
	rural (1) vs rural (2)	***
	rural (1) vs estate	**
	Rural (2) vs estate	**
Level of education of mother	No schooling vs primary	ns
	All other combinations	***
Work status of mother	Not working and working	**
	Not working vs other work	**
	Working in agriculture vs other work	ns
Type of co-residence	two Groups	ns*
(c) Environmental characteristics		
Housing type	Type 3 vs Type 4	ns
	All others	***
Source of drinking water	Pipe vs pub Tap	ns
	All other	***
Toilet facilities	No toilet vs Sanitary	***
	No toilet vs other (excl use)	ns
	No toilet vs other (shared use)	ns
	Sanitary toilet vs other (excl use)	**
	Sanitary toilet vs other (shrd use)	***
	Excl use vs shared use	ns
(d) Health care behaviour		
	FHW visited vs not visited	ns
	Visited a clinic vs not visited	ns
Place of confinement	Hospital vs home	***
Person assisting delivery	Medical vs TBA	***
	Medical vs Other	***
	TBA vs Other	ns
Time of initiation of breastfeeding	all groups	ns*

* significant @ $p < 0.05$ level
** significant @ $p < 0.01$ level
*** significant @ $p < 0.001$ level
ns not significant
ns* none of the pairs in the group

Table A.6.3 Logistic regression parameters relating socio-economic and proximate variable to likelihood of a child being born in a hospital.

Variable	Estimate	S.E	`t' values	Odds ratio
Place of residence	χ^2	**98.2**	**@ 3 df**	**p < 0.001**
Urban	0	-	-	
1.0				
Rural (1)	-1.05	.357	-2.9	0.3
Rural (2)	-1.86	.371	-0.3	0.5
Estate	-2.59	.365	-7.0	0.8
Housing type	χ^2	**15.9**	**@ 3 df**	**p < 0.001**
Type 1	0			1.0
Type 2	-0.41	.205	-2.0	0.7
Type 3	-0.07	.245	-0.3	0.9
Type 4	-0.67	.201	-3.3	0.5
Educational level of mother	χ^2	**34.2**	**3 df**	**p < 0.001**
No schooling	0	-	-	1.0
Primary	0.74	.178	2.1	2.1
Secondary	0.95	.205	4.6	2.6
Higher	1.47	.275	5.3	4.3
Whether seen by a doctor during pregnancy	χ^2	**36.2**	**1 df**	**p < 0.001)**
Yes	0	-	-	1.0
No	-1.43	.231	-6.19	0.2
Source of drinking water	χ^2	**8.6**	**@ 2 df**	**p < 0.01**
Pipe	0			1.0
Public tap	0.60	.249	2.4	1.8
Protected well	0.65	.277	2.3	1.9
Unprotected well or stream or pond	0.34	.278	1.2	1.4
Birth order	**9.5**	**3 df**	**p < 0.01**	
1	0			1.0
2-5	-0.36	.160	-2.3	0.7
6 or higher	-0.74	.253	-2.9	0.5

S.E=standard error of the estimate

Table A.6.4 Parameters of the proportional hazards model fitted to the current status data on weaning for all children aged 0-36 months (currently breast feeding =0, otherwise =1)

Variable	Estimate	S.E	`t' values	Relative risk of weaning
Source of drinking water	χ^2 60.2	@ 3 df	p < 0.001	
Pipe	0			1.0
Public tap	0.16	.110	1.5	1.2
Protected well	-0.43	.113	-3.8	0.7
Unprotected well or stream or pond	0.53	.124	-4.2	0.6
Housing type	χ^2	20.0	@ 3 df	p < 0.001
Type 1	0			1.0
Type 2	-0.12	.087	-1.4	0.9
Type 3	-0.55	.131	-4.2	0.6
Type 4	-0.47	.101	-4.7	0.6
Birth Order	χ^2	14.9	@ 2 df	p < 0.001
1	0			1.0
2-5	-0.22	.074	-2.9	1.0
6 or higher	-0.58	.181	-3.2	0.6
Work status of mother	χ^2	11.6	@ 3 df	p < 0.01
Not working	0			1.0
Working in Agriculture	0.03	.107	0.2	0.9
Non agricultural work	0.47	.133	3.5	1.6

S.E=standard error of the estimate

Table A.6.5 Per cent distribution of children aged 0-36 months included in the proportional hazard model discussed in the text and additional children included in the second model with all births.

Characteristic	No. of Children Surviving		
	Last born[1]	Additional[2]	All[3]
All (number)	1892	491	20.6
Maternal age	***		
Under 25	36.3	51.3	26.8
25-29	30.1	31.4	21.3
30-34	20.2	12.0	13.4
35-49	13.4	5.3	9.3
Birth order	***		
1	26.4	48.1	32.1
2-5	67.2	49.3	16.0
5+	6.4	2.6	9.7
Place of current residence**			
Urban	14.6	12.6	81.7
Rural (1)	58.0	56.4	20.2
Rural (2)	15.8	13.2	17.9
Estate	11.7	17.7	28.2
Housing type	***		
Type 1	36.1	47.0	25.3
Type 2	17.8	37.1	35.1
Type 3	15.0	5.3	8.4
Type 4	31.1	10.6	8.1
Level of education of mother ns			
No schooling	10.8	11.6	21.8
Primary	29.1	32.0	22.2
Secondary	36.2	34.0	19.6
Higher	23.9	22.4	19.5
Source of drinking water	***		
Pipe	8.7	20.8	38.2
Street tap/tube well	15.4	56.8	48.9
Protected well	41.1	10.6	6.3
Unprotected well/river, pond etc	34.8	11.8	8.1

ns=not significant *** significant at $p < 0.001$

** significant at $p < 0.01$

[1] Last born children (aged 0-36 months)except those of pregnant mothers.

[2] Additional children included in the second model

[3] Per cent distribution from the total children (0-36 months old).

Table A.6.6 Per cent distribution of additional children included in Model 2 by place of current residence and source of drinking water (percentages in each cell are expressed in relation to the total number of additional children)

Residential area	Source of drinking water				
	Pipe	Public tap	Port well	Other	% to total (N=491)
Urban	4.7	6.1	1.2	0.6	12.6
Rural (1)	4.1	36.3	7.5	8.6	56.4
Rural (2)	1.2	9.0	1.6	1.4	13.2
Estate	10.8	5.9	0.2	1.2	17.7
All	20.8	56.8	10.6	11.8	100.0

Appendix 7

Table A.7.1 Logistic regression parameters relating proximate and socio-economic characteristics *individually* to stunting*

(only variables significant at the bivariate level are shown in the table)

Variable	Estimate	S.E.	t values	Odds Ratio
Maternal age		**(χ^2= 9.3 @ 4 df)p < 0.05**		
< 20 years	0.00			1.0
20-24	0.08	.402	0.2	1.1
25-29	-0.36	.339	-1.1	0.7
30-34	-0.41	.405	-1.0	0.7
35-49	-0.21	.415	-0.5	0.8
Age of child (months)		**(χ^2= 9.1 @ 3 df)p < 0.05**		
12-17	0.00			1.0
18-23	0.30	.186	1.6	1.3
24-29	0.31	.184	1.7	1.4
30-36	0.55	.182	3.0	1.7
Birth order		**(χ^2= 10.3 @ 4 df)p < 0.05**		
2	0.00			1.0
3	0.22	.158	1.4	1.2
4	0.65	.203	3.2	1.9
5	0.23	.245	0.9	1.3
Birth interval (in months)	**(χ^2= 9.0 @ 1 df)p < 0.01**			
<36	0.00			1.0
36 & over	-0.40	.133	-3.0	0.7
Place of confinement		**(χ^2=23.3. @ 1 df)p < 0.01**		
Hospital	0.00			1.0
Other	0.84	.174	4.8	2.3
Person assisting delivery	**(χ^2=24.8 @ 2 df)p <0.01**			
Medical	0.00			1.1
TBA	0.65	.232	2.8	1.9
Other/no assistance	1.04	.240	4.3	2.8
Ever use of contraceptives	**(χ^2=10.6 @ 2 df)p <0.01**			
Never used	0.00			1.0
Used traditional method	-0.48	.189	-2.5	0.6
Used modern method	-0.49	.155	-3.2	0.6
Source of drinking water		**(χ^2=13.6 @ 3 df)p < 0.01**		
Pipe water	0.00			1.0
Street tap/tube well	0.43	.226	1.9	1.5
Protected well	-0.18	.219	0.8	0.8
Unprotected well/ streams etc.	0.08	.220	0.4	1.1
Toilet facilities		**(χ^2=14.7 @ 2 df)p < 0.01**		
No toilet	0.00			1.0
Sanitary toilet	-0.63	.171	3.7	0.5
Other toilet	-0.52	.169	-3.1	0.6

Table A.7.1 (cont'd)

Variable	Estimate	S.E.	t values	Odds Ratio
Housing Type		**(χ^2=26.9 @ 3 df)**		**p < 0.01**
Type 1 (best)	0.00			1.0
Type 2	0.53	.179	3.0	1.7
Type 3	0.91	.206	4.4	2.5
Type 4 (worst)	0.71	.170	4.2	2.0
Residential area		**(χ^2=67.9 @ 3 df)**		**p < 0.01**
Urban	0.00			1.0
Rural (1)	0.32	.215	1.5	1.4
Rural (2)	0.66	.249	2.7	1.9
Estate	1.83	.270	6.8	6.2
Educational level of mother		**(χ^2=42.3 @ 3 df)**		**p < 0.01**
No schooling	0.00			1.0
Primary	-0.51	.227	-2.2	0.6
Secondary	-0.89	.221	-4.0	0.4
Higher	-1.42	.245	-5.8	0.2
Parental education (joint)		**(χ^2=59.3 @ 4 df)**		**p < 0.01**
Both primary or less	0.00			1.0
One secondary, other higher than secondary	-0.21	.179	-1.2	0.8
both secondary	-0.92	.201	-4.5	0.4
One higher, other less than higher	-1.02	.198	5.2	0.4
Both higher	-1.45	.264	5.5	0.2
Religion of mother		**(χ^2=54.4 @ 3 df)**		**p < 0.01**
Buddhist	0.00			1.0
Hindu	1.50	.219	6.8	4.5
Moslem	-0.30	.359	0.8	0.7
Other	0.41	.245	1.7	1.5
Housing Type		**(χ^2= 9.1 @ 3 df)**		
Type 1 (best)	0.00			1.0
Type 2	0.53	.179	3.0	1.7
Type 3	0.91	.206	4.4	2.5
Type.4	0.71	.170	4.2	2.0
Mother's employment		**(χ^2=41.3 @ 2 df)**		**p <0.001**
Not working	0.00			1.0
Working in agriculture	0.87	.145	6.0	2.3
Other employment	-0.59	.322	1.8	0.6
Father's occupation		**(χ^2=46.3 @ 4 df)**		**p < 0.001**
White collar	0.00			1.0
Other formal sector occupation	0.73	.289	2.5	2.0
Skilled (manual)	0.92	.272	3.3	2.5
Unskilled (manual)	1.42	.254	5.6	4.1
Agriculture	1.01	.327	3.1	2.7

* children whose z-scores less than or equals to -2.00 of the WHO/NCHS median

Table A.7.2 Logistic regression parameters relating proximate and socio-economic characteristics *individually* to wasting* (excluding estate sector)

(only variables significant at the bivariate level are shown in the table)

Variable	Estimate values	S.E. Ratio	t	Odds
Age of child (months)		**(χ^2=46.3 @ 4 df)**		**p <0.001**
12-17	0.00			1.0
18-23	-0.02	.198	-0.1	1.0
24-29	-0.62	.221	-2.8	0.5
30-36	-0.84	.232	-3.6	0.4
Place of residence		**(χ^2=5.5. @ 2 df)**		**p < 0.05**
Urban	0.00			1.0
Rural (1)	0.16	.231	0.7	1.2
Rural (2)	0.57	.268	2.1	1.8
Housing type		**(χ^2=12.8. @ 3 df)**		**p < 0.001**
Type 1	0.00			1.0
Type 2	0.28	.209	1.3	1.3
Type 3	0.59	.284	2.0	1.8
Type 4	0.66	.193	3.4	1.9
Source of drinking water		**(χ^2=19.3 @ 4 df)**		**p <0.05**
Piped into premises	0.00			1.0
Public tap	0.58	.412	1.4	1.8
Protected well	1.23	.383	3.2	3.4
Unprotected well/streams ponds. etc.	1.10	.389	2.8	3.0
Parental (joint) education	**(χ^2=8.4. @ 4 df)**		**p <0.05**	
Both primary or less	0.00			1.0
One primary or less, the other above	-0.06	.190	-0.3	0.9
Both secondary	-0.57	.217	-2.6	0.5
One secondary & other higher	-0.71	.216	-3.3	0.5
Both higher	-1.14	.280	-4.1	0.3

* children whose z-scores less than or equals to -2.00 of the WHO/NCHS median

Appendix A.8.1.

Brief comment on SLDHS data on diarrhoeal morbidity and supplementary food

Diarrhoeal morbidity

SLDHS included two questions from which diarrhoeal morbidity could be estimated: first, for each surviving child born since 1.1.1981, the respondents were asked whether the child had had diarrhoea in the 24 hours before the survey. If the answer to this question was `no' then a second question was asked; whether the child had had diarrhoea in the two weeks before the survey. Although diarrhoea was not precisely defined in the DHS program, probably because the aetiology, symptoms, and signs of diarrhoea differ between different types of diarrhoea and between individuals (for instance see Chen, 1983:) the SLDHS interviewers were asked to describe the condition to the respondent, as meaning the passing of watery stools 3-4 times a day. It is however doubtful whether these instructions were actually followed all the time. Nor did the survey collect details such as the number of episodes, duration of illness and severity of diarrhoea some of which have now been incorporated into stage 11 of the DHS questionnaire.

Prevalence levels estimated from the responses to the two questions included in the SLDHS yielded for children aged 1-59 months 2 per cent in a 24 hour period and 6 per cent in the two weeks reference period. Both these estimates are low by any Third World standards. Morbidity from diarrhoeal diseases in Sri Lanka is expected to be low as a result of the state welfare policies discussed in Chapter 1, which included free education and curative and preventive health care covering even the remote parts of the island. Over the years these policies have resulted in increased literacy and heightened the public-health consciousness of the people. Yet the possibility of underreporting cannot be ruled out.

The observed relatively high ratio of 24-hour to two weeks prevalence rates could be indicative of diarrhoea of long duration or of certain problems in the data. In

general, morbidity data derived from cross-sectional studies based on recall often suffer from the problem of underreporting for several reasons among which lapses in recall are the most common. Blum and Feachem (1983), reviewing the available evidence on diarrhoeal morbidity studies draw, attention to the possibility that even an adult may not be able to accurately report his or her own diarrhoea history. In the case of children the mother, the respondent for the SLDHS, may not be the best person to report diarrhoeal morbidity of children. This may be the case with mothers working outside the home including the estate mothers who often work in the estate far away from the line-rooms, leaving the children at creches or in the hands of others, older children or the husband.

It has been found in some cultures, for certain diseases such as diarrhoea, there is a tendency not to report their occurrence, as some families may consider it to be a cause for shame to suffer from such`dirty' diseases, while others tend not to report them assuming that as a result of reporting many other investigations such as stool testing will follow. The accuracy of the data also depends on the length of the reference periods used. In general the shorter the reference period for the reporting of diarrhoeal morbidity the more likely it is to be accurate. In situations such as in Sri Lanka where reported morbidity prevalence in the 24-hour period is extremely low, very short reference periods for data collection preclude any detailed analysis. It has been suggested that a 48-hour reference period is probably the best for accuracy of reporting diarrhoea (Blum and Feachem, 1983). According to a study in Bangladesh the recall data on diarrhoea morbidity reporting was found to be reasonably accurate only up to 48-hours, beyond which the accuracy declined substantially with increasing length of the recall period and the degree of severity of diarrhoea (Alam, Henry, and Rahaman, 1989)

In the absence of a valid definition of diarrhoeal diseases, responses cannot be taken as standardized; the reporting of cases will depend on the mothers' perception of and attitudes to diarrhoea illness. Another factor also complicates the picture:

seasonality. In Sri Lanka there are two periods before monsoon rains where diarrhoea is endemic; March-April and August-September (Vitharana and Velauthapillai, 1985:92). This factor is likely to have mainly affected the dry zone areas where water problems are acute in those periods. The SLDHS field work began in January 1987 and concluded in April. By the end of February three fourths of the children under reference were covered and of the remaining children 82 per cent were living in areas outside the dry zone. Thus the effects of seasonality on the reported diarrhoea appears to be minimal.

(b) Supplementary food

Two main categories of data were gathered in the SLDHS on giving supplementary food; one consisted of the various food items given to the child in the 24 hour period before the survey. The other collected data on whether or not specific food items had ever been given to the child. The former information refers to giving any liquid, juice, formula milk, cow's milk and solids to the child. As the information sought was current (i.e giving such food items in the 24-hour period before the survey) the level of accuracy of the data is expected to be high. However the information collected was restricted to a select group; these questions were asked of the mothers in respect of their youngest child born since 1.1.1981 and being breastfed at the time of the survey. Obviously this gives rise to a selectivity bias in the data.

The other information collected was part of the country specific questions. These questions were included in order to assess the age pattern of initiation of some of the food items commonly given to Sri Lankan children and to ascertain some aspects of their use; regular use and status of breastfeeding when other food items are introduced to the child's diet. In the question design an attempt was made to include possible local terms rather than technical terms employed for such food. For instance, the Sinhala version of the questionnaire used the term `half cream' (instead of *ardha yodaya sahitha kiri piti*) and `full cream' (instead of *purna yodaya sahitha kiri piti).*

In general, respondent's reports on ages at which each specific food item was given to the babies are subject to inaccuracies due to memory lapses or other preferences (digit or preferred months). No attempt has been made in the research to validate the reported data on giving various food items, but in the analysis it was assumed that they were reasonably accurate to draw broad conclusions. Apart from the data on whether children were ever given specific food items, ages at which they were given and ages at which any such food was given on a regular basis, no information was obtained on items such as the regularity of feeding, and the quantities given to relate them meaningfully to child undernutrition.